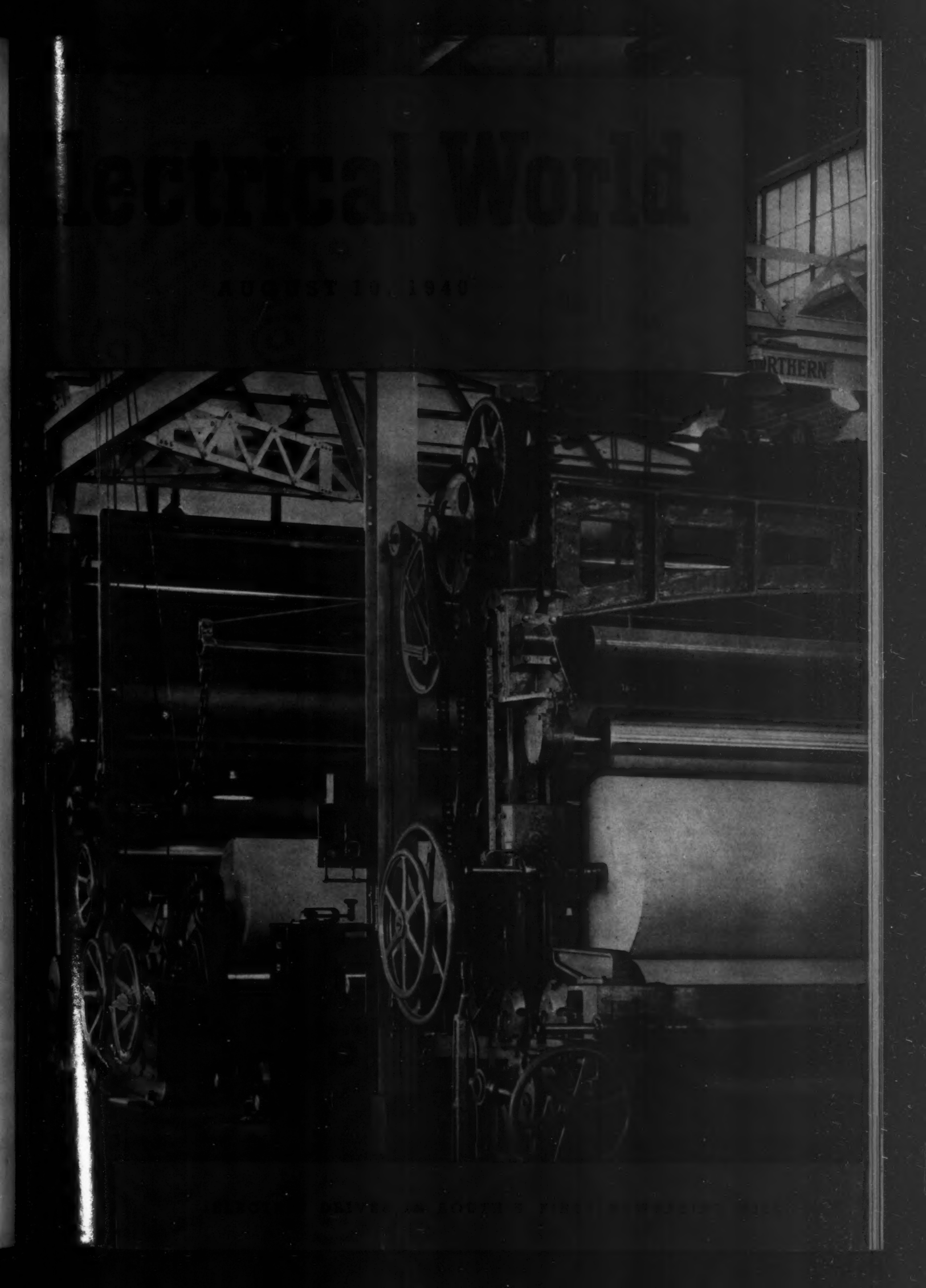
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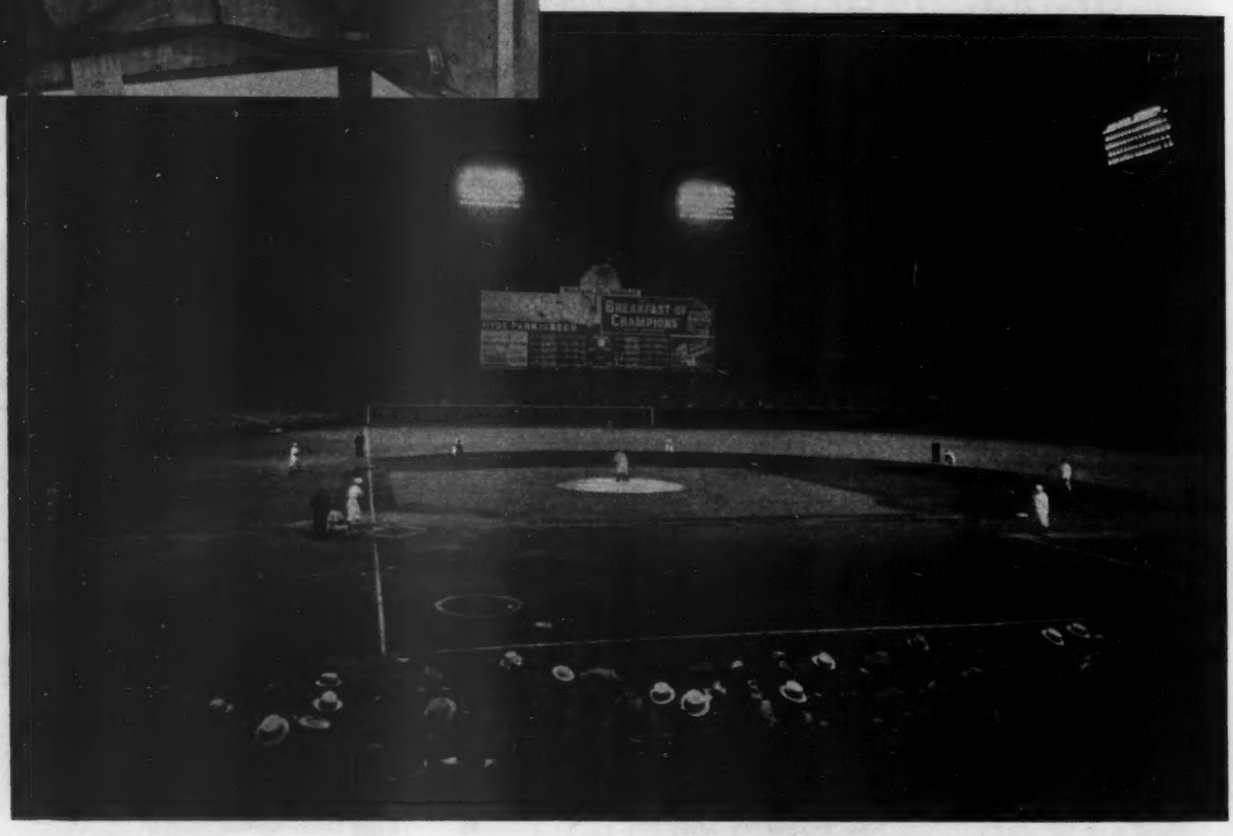

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Engineering Personalities

Twenty-five or more years ago we had great electrical engineers who gave direction to the development of this industry. It was in the thinking of these men, from which came better products and new fields of service, that the electrical industry derived its strength. In fact, the engineer became so dominant that the degree to which he was relied upon began to be declared a business weakness and we turned for leadership to others who had a more commercial or corporate viewpoint.

Undoubtedly to depend too much on any one kind of thinking creates a situation that is somewhat akin to inbreeding in animals. A balance and a fresh viewpoint are necessary for business and industry health. Nevertheless, we cannot escape the fact that an industry founded on engineering cannot easily minimize the importance thereof without losing considerable of its personality and strength.

Where are the modern engineers to match those giants of a quarter of a century ago or longer? One cannot doubt their existence, but too few of them are generally known. The great engineers of yesteryear had not the advantages of men of today, either in education or in the size, variety or character of problems. The very extent of electrical operations and the degree to which modern civilization is dependent upon it give rise to problems that could not possibly exist when the industry was young.

Thus it will be seen that this is not meant to intimate that the electrical engineer of today is any less capable than his predecessors. In fact, the ramifications of today's problems require him to be more broadly trained in order to cope with them.

Possibly the very intensity of our current problems is such as to keep the engineer's nose to the grindstone, with the result that he is unable to find time to engage in engineering exploration. In any event, too few engineers today have that healthy unrest regarding things as they are.

Admittedly no industry can afford a continued close succession of startling improvements. Time for consolidation of engineering gains is needed for stability. That does not mean, however, that we have to relax and continue to bask in the glory of our pioneers.

When an industry such as ours is founded on engineering, it needs new engineering personalities to arouse public appreciation of our progress and to stimulate thinking and kindle ambition on the part of the younger men coming into the field.

There are modern giants of electrical engineering in education, manufacturing, utility work, consulting practice. Only a handful of them are known to the public or to the industry. The others need to be uncovered, to be brought out into the sunshine. They must be given more latitude to express themselves, more opportunity to give utterance to broad, directive thinking. With such a policy we can repopulate the ranks of electrical engineering personalities.

A Capacitor Program for Distribution Betterment*—I

Voltage improvement is one objective — Mounting arrangement is simplified — Compensator adjustment for correlation with capacitor correction

THEODORE SEELY and PAUL H. JEYNES, Public Service Electric & Gas Company, Newark, N. J.

SHUNT CAPACITORS have been employed to a limited extent on the electric distribution system of Public Service Electric & Gas Company (N.J.) during the past two decades. Since 1937, however, the new type outdoor shunt capacitor unit, which has resulted from notable advances in manufacture and standardized design for best utilization, has found greatly expanded fields of application by reason of its more ready installation, greater flexibility and reduced cost. At the current installed cost of less than $7 per nameplate kva. the shunt capacitor frequently has marked economic advantages over alternative plant additions, while its flexibility and mobility make it peculiarly attractive under present load conditions.

There are three distinct fields of shunt capacitor application:

1. They can effect postponement of generators, substations, or other plant required to supply growing loads, by improving the power factor.
2. They may be used to improve the voltage level on distribution circuits.
3. They may be economically justified by the reduced kilowatt-hours of copper losses which accompany the improved power factor.

The majority of the individual installations on the Public Service system has been for purposes of voltage improvement, but the greater part of the total kva. as well as the important savings realized have been associated with postponement of substation extensions. Sometimes, of course, a single installation will accomplish all three objectives. In order to facilitate the most economic solution under various conditions, practical methods for studying all the possibilities have evolved along with the more general use of capacitors, and some of these developments will be described.

Installation Simplified

Shunt capacitor installations in lieu of plant facilities or for improvement of general distribution voltage levels are made in standard banks of twelve 15-kva. units in order to realize minimum installed cost. As furnished by the manufacturers, the four-unit hanger which is employed for such installations requires two additional crossarms for pole mounting—one arm for hanging and one "kick" arm. By drilling one additional hole in each of the hanger irons, it is possible to lower the entire supporting bracket assembly on the hangers (Fig. 1). The increased clearance over capacitor-unit bushings so obtained, together with top-groove insulators, enables installation of the hanger on the line arm, with the addition of a "kick" arm, and so eliminates one crossarm which would otherwise be required.

Unlike the distribution transformer, where blown fuses result in customer outage and consequent definite notification to the utility, the shunt capacitor has no convenient indication of non-operation. In fus-

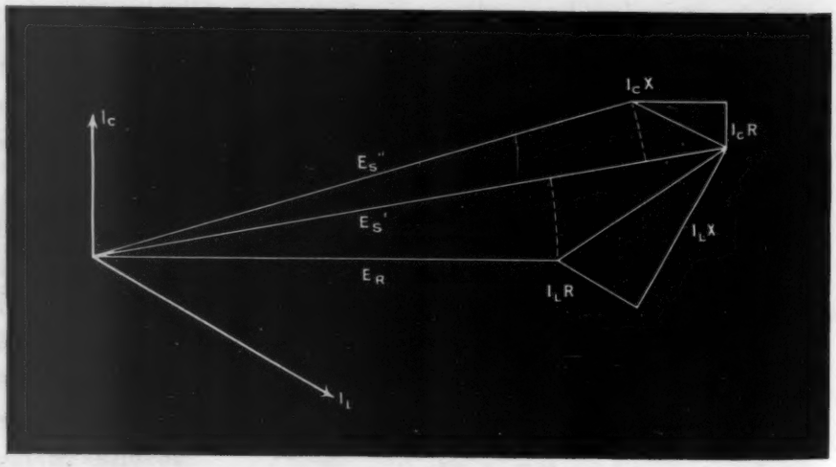

FIG. 2—Fixed voltage boost, independent of load or power factor
E_R =Receiving voltage.
E_S'=Sending voltage required to deliver E_R with load current I_L through inductive circuit $R+jX$.
E_S''=Sending voltage required to deliver E_R with load current I_L and capacitor current I_c, through inductive circuit $R+jX$.
$E_S' - E_S''$=Decrease in voltage drop effected by addition of capacitor current I_c, approximately equal to $I_c X$.

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ing capacitors, therefore, the indicating-type cutout is used to afford a visual indication of capacitor operation. Routine observation of the indicating fuses is made at monthly intervals.

To date all installations have been equipped with lightning arresters, as indicated in Fig. 1. It is now believed that arresters may be omitted without appreciably increasing the lightning hazard to the equipment, provided that the primary neutral point is solidly grounded at the point of installation. The adoption of this method of installation will accomplish some decrease in cost by omission of the arresters and use of single-bushing capacitor units.

Shunt capacitor cases carry a static charge to ground. On the three-phase, four-wire, 4-kv. distribution system of Public Service, with neutral grounded only at the substation, each phase installation of a 180-kva. bank was found to have a potential to ground of 800 volts. As protection to linemen, the capacitor cases are solidly grounded, as is also shown in Fig. 1, this ground connection carrying about eight milliamperes.

For voltage improvement at the end of long single-phase branches, and for correction of voltage drop produced by the pole-type constant-current transformer, one or two 15-kva. capacitor units are usually required. For such installation the single-unit bracket is employed. Where two units are required new mounting holes are drilled in the bracket to permit installation of the two units in a single bracket.

Attachment of capacitors at the end of the usual inductive circuit results in a fixed voltage boost, independent of load or power factor, which is greatest at the end of the line where it is most needed and tapers off toward the supply source. Computation of this voltage boost at any point on an unregulated circuit is not difficult, since it is equal to I_cX, where I_c is the capacitor current in amperes and X is the circuit reactance in ohms. The vector diagram in Fig. 2 shows the derivation of this expression.*

If the circuit is equipped with automatic voltage regulators precise determination of the effect on voltage becomes a nice problem, but fortunately a simple solution has always proved adequate. The complications arise from two sources—the uncertain effect of capacitors on the voltage drop in three-phase sections of the circuit, and the action of the compensator which recognizes the improvement in power factor and reduction in current and partly offsets the capacitor effect by reducing the outgoing voltage at the substation.

For correction of low-voltage conditions on circuits having excessive internal voltage drop, *i.e.*, from first

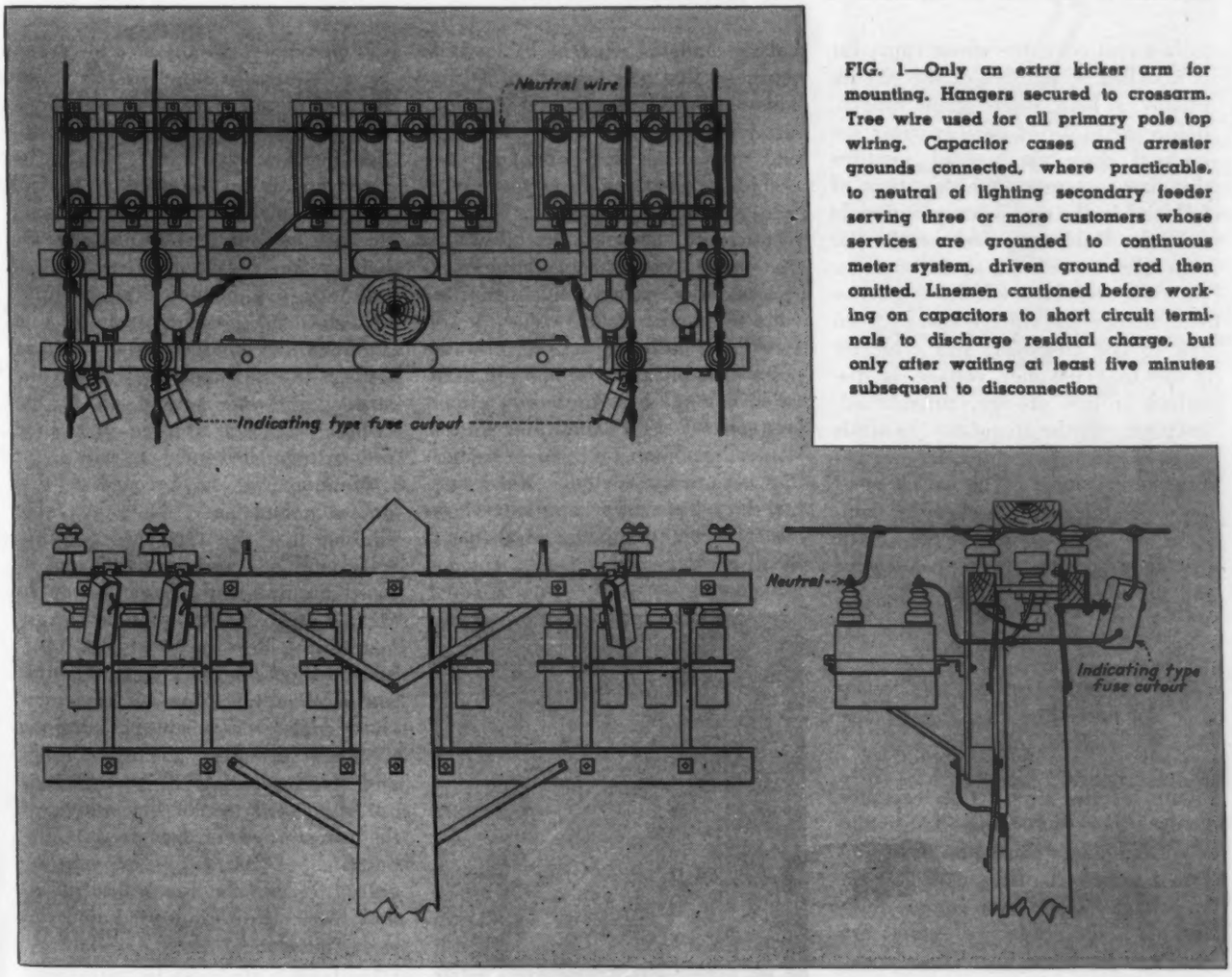


FIG. 1—Only an extra kicker arm for mounting. Hangers secured to crossarm. Tree wire used for all primary pole top wiring. Capacitor cases and arrester grounds connected, where practicable, to neutral of lighting secondary feeder serving three or more customers whose services are grounded to continuous meter system, driven ground rod then omitted. Linemen cautioned before working on capacitors to short circuit terminals to discharge residual charge, but only after waiting at least five minutes subsequent to disconnection

*See "Applying Shunt Capacitors to Distribution Systems," by Sherwin Wright, in the *Electric Journal*, May, 1937.

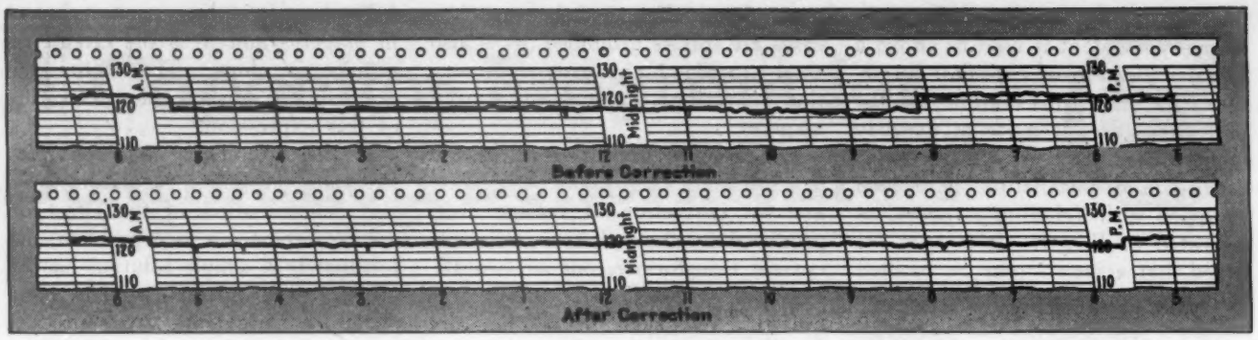


FIG. 3—Capacitor (of three 15-kva. units) restores voltage. Low voltage caused by 30-kw. pole-type constant-current transformer improved to 120 volts by installation of three 15-kva. shunt capacitors

to last customer, the shunt capacitor is installed at the end of the circuit, usually a long single-phase branch. Before addition of the capacitor the internal drop experienced requires that first-customer voltage at time of full load be the maximum permissible —in the Public Service system 120 volts plus 3 per cent, or 123.6 volts. The sole function of the capacitor is to reduce the voltage spread from first to last customer, and evidently if the first-customer voltage is disturbed in this process, suitable adjustment of the regulator controls must be made to restore the original maximum voltage. The net effect of the capacitor may therefore be computed as I_cX, where X is the circuit reactance between the first customer and the capacitor location.

Evaluation of X

The major part of this total reactance is found in the single-phase branch involved, and this is readily determined. For the polyphase portion of the circuit the reactance of the single-phase wire is usually adequate. There should be little concern if the effect of the capacitor on the voltage has not been exactly forecast, for the capacitor units are small and have low installation costs, and modification of an installation or actual removal to a more desirable location involves no severe penalty. In most cases the amount of capacity required is of the order of 15 or 30 kva.

In applying capacitors for such voltage improvement it is usually discovered that the voltage rise effected at time of light load limits the amount which can be installed. Frequently this light-load voltage limitation prevents the full improvement required at time of full load. This condition suggests the use of a voltage-actuated control to energize the capacitor when required and to remove it from the circuit when its effect is undesirable. Such capacitor and control assembly would be preferable to the single-step branch-feeder voltage booster, in that the location of the assembly would be that point where the maximum voltage variation occurs, and in that the voltage improvement would be effected not only at and beyond the point of application but also in graduated amount over the entire circuit between location and the source. Control equipment for such application is not now available, but manufacturers have been approached on the subject and it is believed that it shortly will be developed.

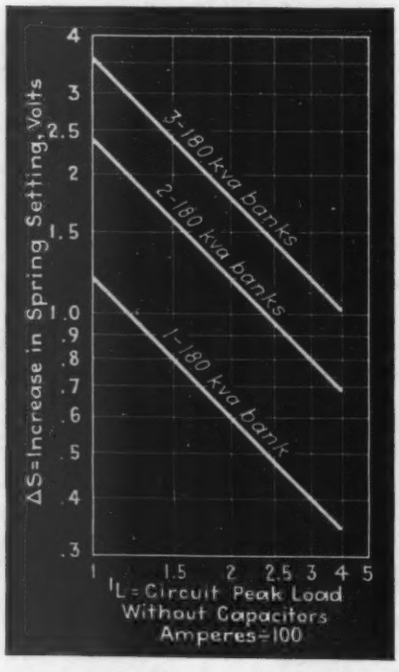


FIG. 4—Recommended increase in no-load spring setting of contact-making voltmeter (above 121-volt setting) with capacitors located at first feed point. The increase, S is 4.2 times the ratio of I_c/I_L.

Pole-type constant-current transformers, used to supply series street-lighting circuits from the power lines, are a common source of voltage difficulties, since they are usually located far out on the primary beyond the range of substation street-lighting circuits, and their power factor is inherently poor—about 75 per cent at full load and 55 per cent at three-quarters load. The first chart of Fig. 3 shows the characteristic drop in voltage that is experienced when the street lights are turned on in the evening and not restored until they are extinguished next morning.

Manufacturers have recognized this difficulty and have made available equipment of this type incorporating self-contained capacitors sufficient to raise the full-load power factor to 99 per cent leading. Under many conditions, however, even more correction is necessary. This is of course an ideal application for the new small units, which can be hung on the same pole with the transformer and shunted across it, so that they are connected to the line whenever the transformer is energized. Computation of the capacitor size required for complete neutralization of the voltage drop is quite simple and is as follows:

The familiar expression for voltage drop is

$$E = I\ (R \cos \Theta + X \sin \Theta)$$

where I is the primary current of the transformer, Θ is the power factor angle of the current, and R and X are the line constants.

The voltage improvement effected by the capacitors is $E = I_cX$, as discussed above.

For complete neutralization of the voltage drop these expressions may be equated, or

$$I_cX = I\ (R \cos \Theta + X \sin \Theta) \text{ whence } I_c = I\ (\frac{R}{X} \cos \Theta + sin\ \Theta)$$

[*Continued on page 121*]

Uses Rubber Protective Equipment on 13.2 Kv.

Utility develops new safety practices and insulator changing technique as result of rush changeover job of 13.2-kv. system to 33 kv. — Evolved practices simplify rural line maintenance

MARTIN J. URNER, Potomac Edison Company*

TO EXPEDITE a rush changeover from 13.2 kv. to 33 kv. of a distribution system supplying four small towns a technique was developed by the Potomac Edison Company for live-line work on 13.2-kv. circuits which changed previous conceptions of the limitations of work with rubber protective equipment and resulted in approval of new practices which greatly simplify rural line maintenance problems.

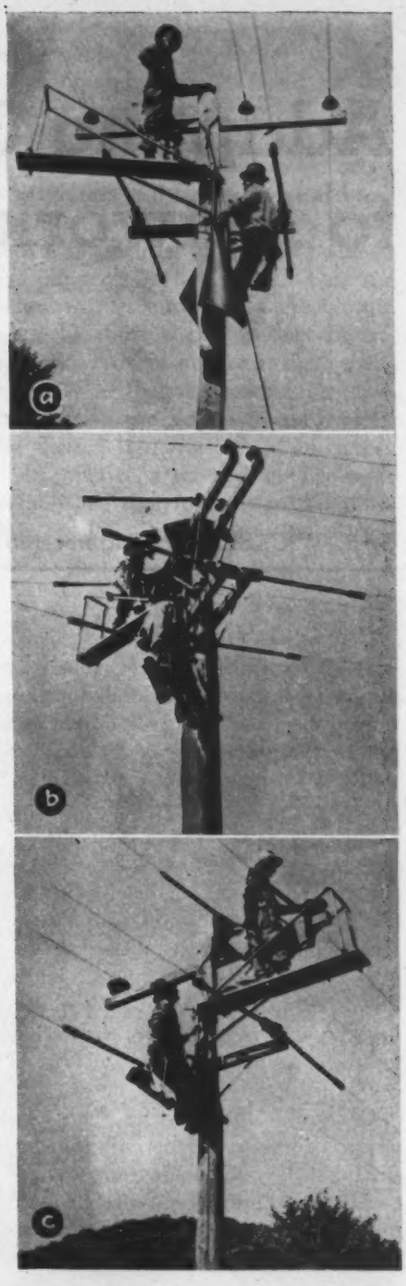
Changing insulators within the 60-day time limit imposed on the job, without interrupting service, presented the most difficult problem. Of the 35 miles of 13.2-kv. line which had to be reinsulated 10 miles is part of a loop circuit which could be taken out of service a section at a time and worked dead. However, there were left some 1,500 insulators which it was felt should be changed hot, and some method had to be developed which was speedy and safe.

After considering the use of regular hot-line tools for changing pin-type insulators, that method was dropped because of slowness and cost. For a number of years Potomac Edison has approved working on live lines on voltages up to 6,900-volt delta, using 20,000-volt rubber gloves and rubber protective equipment. Since experience with this practice has been very satisfactory, it was finally decided that if the linemen could work from some kind of insulated pole platform which could be quickly installed and removed the job could be done safely, as well as speedily, with the same type of equipment.

A pivot-type pole platform with collapsible platform railing, made by the Tips Tool Company, which has wood members of the kind ordinarily used for hot-line tools, was selected, and a picked crew of seven men was given special training for the job. Each man was assigned definite duties and before hot work was attempted the various operations were practiced until each man knew his part thoroughly. During the whole insulator changing procedure operations were so co-ordinated that only materials actually needed at the moment were on hand for the man at the pole top. This added to the safety of the work and was easily accomplished by use of an endless handline run through a block.

Crew prefers new method

After several days' experience the crew was asked to state whether they preferred to continue the new method or to complete the job with the hot-line tools with which they were more familiar. The crew was unanimously in favor of the new method, and in a total of twelve working days changed 1,500 insulators, at a rate of about two changes per man-hour. At first it was planned to work only under ideal conditions of dry poles and clear weather, but later on work was done at any time except when rain was falling. Since then this method has been regularly used in one district for general live-line work on 12.0-kv. grounded neutral rural lines and it has proved to be convenient, safe and economical.



RUSH CHANGEOVER of 13.2-kv. system to 33 kv. results in new insulator changing procedure

The circuits shown are three-phase, 13,200 volts on top and single-phase, 2,300 volts below. First step was the covering of all live 2,300-volt conductors with rubber line hose and insulator hoods. Then the pole platform was hoisted into place and secured (a). Working from the pole platform, which was swung into proper position, the lineman protected his working space with line hose and rubber blankets. The hot conductor to be untied was also covered with line hose, leaving only the insulator exposed. When the tie wire was removed the hot conductor was laid on the crossarm with the line hose slid forward to prevent contact between the conductor and the crossarm. After the old insulator was removed and the new one was installed this procedure was reversed. In (b) the lineman is changing the first insulator; in (c), he is installing the last insulator, preparatory to taking down the pole platform.

* Assistant to Operating Vice-President.

Adapting 3-Wire Lighting to Network Service

Buildings changed over to a.c. network supply require changes in wiring — Adaptation of old three-wire systems is possible in some cases

C. S. WICKSTROM, Engineering Department, Commonwealth Edison Company

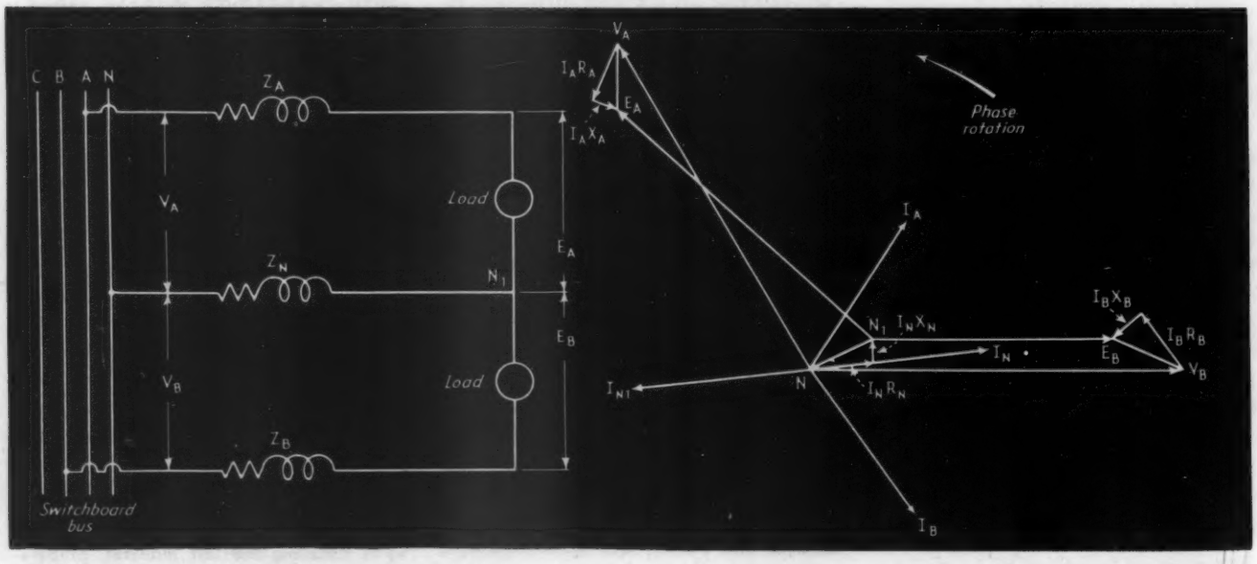
THE USE of three-phase, four-wire mains in buildings for the distribution of electrical energy for light and power is rapidly increasing, due particularly to the growth of the a.c. network system in densely loaded areas. The a.c. network system is displacing the d.c. system, which has been the common medium of distribution in the business districts of many of the larger cities. Consequently, it becomes necessary to change or adapt the distribution mains in the buildings previously served by a d.c. system to conform with the new type of energy supply.

Generally, the existing load and wiring conditions in the buildings are such that the old three-wire mains are useless and must be replaced with four-wire mains. However, on occasions conditions are such that it is possible to use the existing three-wire mains by connecting them to two of the three phases and neutral to produce an open-Y connection. If this can be done a considerable reduction in the cost of the conversion can be effected. Also, in small new buildings, where the load is relatively light, the use of the open-Y circuit is possible.

A circuit of this type is adapted primarily to lighting use, with the lamps connected between each of the two phases and neutral. However, single-phase motors and appliances can also be operated satisfactorily either at 120 volts connected from phase to neutral or at 208 volts connected phase to phase. Operation of three-phase equipment is not possible.

This circuit is rather treacherous in that the voltage losses in it tend to be rather large and voltage unbalances between the two phases at the load may become excessive. Therefore, caution must be exercised in attempting to apply it to be certain that satisfactory voltage regulation will be obtained.

Because the open-Y circuit is essentially an unbalanced form of the four-wire circuit, the neutral will carry current under any condition of load balance between the two phases. The neutral current will be minimum and equivalent to the phase currents when the latter are equal. The current in the neutral, being greatly displaced in phase relationship to the phase currents, will produce in the conductor an impedance drop which is out of phase with the drop in each of the phase wires. Gen-



SCHEMATIC DIAGRAM and vectors for open-Y wiring

erally, the combination of the impedance drop in the neutral with the drop in each of the phase wires produces a voltage at the load which is unbalanced, even though the load may be balanced on the two phases. The exact amount of voltage unbalance for any particular installation will depend upon the load balance and the power factor of the load.

Vector Relations

In the vector diagram V_A and V_B represent the applied voltage for A and B phases respectively, forming an angle of 120 deg. I_A and I_B represent the current for the same phases and lagging their respective voltages. I_N indicates the current in the neutral, its value being dependent upon the magnitude and direction of I_A and I_B. The impedance drops in the A and B phase conductors are shown as V_AE_A and V_BE_B. Also, the impedance drop in the neutral conductor, causing the neutral point of the circuit at the load to be shifted to N_1, is represented by NN_1. Then the vectors N_1E_A and N_1E_B or simple E_A and E_B represent vectorially the voltage at the loads. These voltages can be determined mathematically by the use of the following equations, employing vectorial notations:

$$E_A = V_A - I_AZ_A - I_NZ_N$$
$$E_B = V_B - I_BZ_B - I_NZ_N$$

where Z is the impedance of the conductors, or more simply when three conductors of the same size are installed, which is generally the case

$$E_A = V_A - Z\ (I_A + I_N)$$
$$E_B = V_A - Z\ (I_B + I_N)$$

Reference to the vector diagram, which was drawn for equal loads and power factors on both phases, shows that the voltage on the leading phase at the load, N_1E_A is considerably greater than the voltage on the lagging phase N_1E_B. Balanced voltage at the load can be obtained in the illustrated case, assuming the power factor and the total load of the two phases remain constant, by shifting a definite amount of load from B to A phase. The pressures could be equalized also, assuming the current in both phases remains constant, by changing the power factor (in the case cited, an increase in power factor) a definite amount.

Table I shows the voltage drop per 100 feet on each of the two phases with full balanced load at 95 per cent power factor in the conductors. This table should be useful for the average installation supplying principally lighting load with some motor or appliance load. As the drop is directly proportional to the current flowing and the length of the circuit, the drop with other currents and circuit lengths can readily be determined by applying the correct proportion to the values shown if the load is balanced and the power factor is 95 per cent.

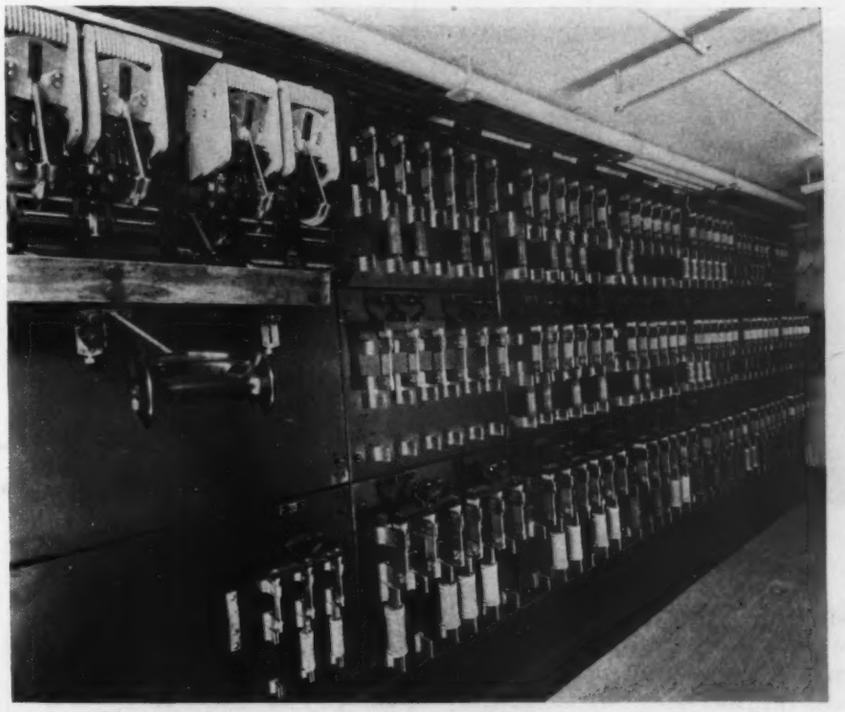
It will be noted from the table that the greatest drop at 95 per cent power factor load occurs on the lagging phase for No. 6, No. 4 and No. 2 wire, while for the larger wire sizes the greatest drop occurs on the leading phase. The use of No. 1 wire with load at this power factor will result in approximately equal drops on both phases and consequently the voltage at the load will be balanced. The reason for the change in the phase on which the greatest drop occurs, as the size of the conductor increases, lies in the ratio of the resistance to reactance of the wire, which causes the resistance drop in the conductor to predominate in the smaller size and the reactance drop to have the greatest influence in the larger sizes. The unbalance in voltage at the load with balanced current becomes more serious as the capacity of the conductors increases; in fact, with cables of 1,000,000 circ.mil capacity and larger, a boost on the lagging occurs at the power factor under consideration.

Because of the inherent rather large voltage loss and tendency toward unbalanced voltage in the open-Y circuit it is essential that the impedance per ampere be kept low. This, in other words, means that the circuit must be short if the conductors are to carry current approximating their capacity or that the conductors must be large in proportion to the load to be carried if the circuit is long.

In practice, a general rule has been established that for new installations the open-Y circuit be installed for loads between 5 and 15 kw. For loads less than 5 kw. a single-phase, two-wire circuit is used and for loads larger than 15 kw. a complete three-phase, four-wire circuit is recommended. In no case is wire of less than No. 6 capacity used, and the upper limit for capacity is dependent upon the load and the voltage regulation desired.

No specific rules can be set down to determine the possibility of using existing wiring in buildings being connected to a.c. supply. Each installation must be given individual consideration.

Recently in Chicago several large buildings have been changed to the



SWITCHBOARD in building changed from d.c. to a.c.

Table I—Voltage Drops on Open-Y Circuit

Wire Size	Min. Size Conduit	Reactance per 1,000 ft.	Resistance Per 1,000 ft. at 50 Deg. C.	Full Load Current in Amps.	Volts Loss per 100 Ft. Leading Phase	Volts Loss per 100 Ft. Lagging Phase
No. 6	1¼	0.0510	0.4416	50	2.52	3.55
No. 4	1¼	0.0456	0.2778	70	2.44	3.08
No. 2	1½	0.0446	0.1747	90	2.21	2.44
No. 0	2	0.0427	0.1114	125	2.23	2.08
No. 2/0	2½	0.0452	0.0889	150	2.37	1.89
No. 3/0	2½	0.0425	0.0704	175	2.35	1.68
No. 4/0	2½	0.0398	0.0558	225	2.59	1.62
250 MCM	2½	0.0378	0.0473	250	2.66	1.47
300 MCM	3	0.0401	0.0394	275	2.67	1.21
350 MCM	3	0.0382	0.0338	300	2.65	1.09
400 MCM	3	0.0366	0.0296	325	2.64	0.95
500 MCM	3	0.034	0.0237	400	2.84	0.81
600 MCM	3½	0.0355	0.0197	450	3.06	0.53
700 MCM	3½	0.0334	0.0169	500	3.09	0.40
750 MCM	3½	0.0329	0.0158	525	3.15	0.35
800 MCM	3½	0.0322	0.0148	550	3.20	0.29
900 MCM	3½	0.0308	0.0131	600	3.21	0.17
1,000 MCM	4	0.0327	0.0118	650	3.51	*—0.0924

*Boost.

a.c. network system wherein very few changes in the lighting mains were made. Table II shows the working data accumulated for one of the buildings. This building occupies an area of approximately half a square block and ranges in height from six to eight stories. While most of the risers in the building are long, the conductors are large and the load on each is relatively small. Table II shows the size and length of the conductors, the load on each of the phase conductors and the calculated voltage drop from phase to neutral for both d.c. and a.c. supplies. The a.c. calculations were readily made by reference to Table I.

Because the location of the old d.c. switchboard was undesirable, the building management decided to build a new switchboard in a different location. This accounts for the variation in lengths of the risers in the two sets of data shown in Table II. Each of the three 800,000-circ. mil conductors forming the risers indicated by * were in separate 2-in. conduits. As this arrangement was not practicable with a.c. supply because of the large inductance in such a circuit, these risers were replaced as indicated with four-wire mains.

It was decided that 2 per cent or 2.4 volts (120 volts) drop in the risers could be permitted. Calculations showed that the voltage drops in all but two of the mains were well within this limit. The drops in these risers Sec. 2N, 3 and 4 floors, and Sec. 2N, 5 and 6 floors, exceeded the limit by only 0.2 and 0.3 volt respectively. The decision was made that if necessary the load could be unbalanced on the risers to place the heavier load on the lagging phase, thus reducing the voltage drop on the leading phase.

Tests made on completion of the change to a.c. confirmed the calculations. It developed that on the riser for Sec. 2N, 3 and 4 floors the load had been somewhat reduced, thus decreasing the voltage drop as calculated. On riser 2N, 5 and 6 floors the lagging phase was carrying a heavier load than the leading phase, which resulted in a maximum drop of 2 volts in the riser. Consequently,

[*Continued on page 62*]

Table II—D.C./A.C. Network Changeover Data

	D.C. Data				A.C. Data			
	Riser Data				Riser Data			
	Size in Mcm	Length in Feet	Load in Amps. per Bus	Voltage Loss (Calculated)	Size	Length in Feet	Load in Amps. per Phase	Greatest Voltage Loss (Calculated)
Sec. 1 Sub. Base., Base., & 1st Fl.	3-400	225	45	0.27	3-400 Mcm	215	45	0.78
Sec. 1 3 & 4 Fl.	3-600	265	95	0.43	3-600 Mcm	255	95	1.63
Sec. 1 5 & 6 Fl.	3-500	310	100	0.67	3-500 Mcm	300	100	2.13
Sec. 2 N, Sub. Base., & Base.	3 No. 3/0	250	25	0.40	3 No. 3/0	295	25	1.00
Sec. 2 N, 1 & 2 Fl.	3-500	270	65	0.38	3-500 Mcm	305	65	1.41
Sec. 2 N, 3 & 4 Fl.	3-600	300	115	0.62	3-600 Mcm	335	115	2.60
Sec. 2 N, 5 & 6 Fl.	3-700	330	120	0.56	3-700 Mcm	365	120	2.72
Sec. 2 S, Sub. Base., Base., 1 & 2 Fl.	3-600	320	70	0.40	3-600 Mcm	285	70	1.38
Sec. 2 S, 3, 4, 5 & 5 Fl.	*3-800	375	95	0.46	4-500 Mcm	340	63	0.50
Sec. 3 E, Sub. Base., Base., 1, 2 & 3 Fl.	3-70	280	55	0.24	3-700 Mcm	350	55	1.19
Sec. 3 E, 4, 5 & 6 Fl.	3-350	315	15	0.15	3-350 Mcm	385	15	0.50
Sec. 3 W, Sub. Base., Base., 1 & 2 Fl.	*3-800	470	25	0.16	4-500 Mcm	510	17	0.18
Sec. 3 W, 3, 4, 5 & 6 Fl.	*3-800	525	45	0.32	4-500 Mcm	565	30	0.37
Sec. 4 E, All Floors.	3-400	275	65	0.48	3-400 Mcm	345	65	1.75
Sec. 4 W, All Floors.	3-600	420	30	0.23	3-600 Mcm	460	30	0.95
Sec. 5 All Floors.	3-400	225	50	0.30	3-400 Mcm	265	50	1.08
Sec. 6 All Floors.	3-600	210	110	0.41	3-600 Mcm	250	110	1.85
Sec. 7 All Floors.	3-600	100	100	0.18	3-600 Mcm	140	100	0.95
Sec. 8 All Floors.	3-400	100	60	0.16	3-400 Mcm	130	60	0.65
Sec. 9 E, All Floors.	3-250	140	55	0.33	3-250 Mcm	60	55	0.35
Sec. 9 W, All Floors.	3-300	235	50	0.42	3-300 Mcm	225	50	1.10
Sec. 10 E, All Floors.	3-500	140	45	0.14	3-500 Mcm	60	45	0.19
Sec. 10 W, All Floors.	3-500	265	55	0.31	3-500 Mcm	190	55	0.75
Sec. 11 N, Sub. Base., Base., & 1st Fl.	3-500	225	25	0.12	3-500 Mcm	265	25	0.47
Sec. 11 N, 2, 3 & 4 Fl.	3-500	255	20	0.12	3-500 Mcm	295	20	0.43
Sec. 11 N, 5, 6, 7 & 8 Fl.	3-600	315	40	0.23	3-600 Mcm	355	40	0.97
Sec. 11 S, All Floors.	3-750	190	30	0.08	3-750 Mcm	230	30	0.41

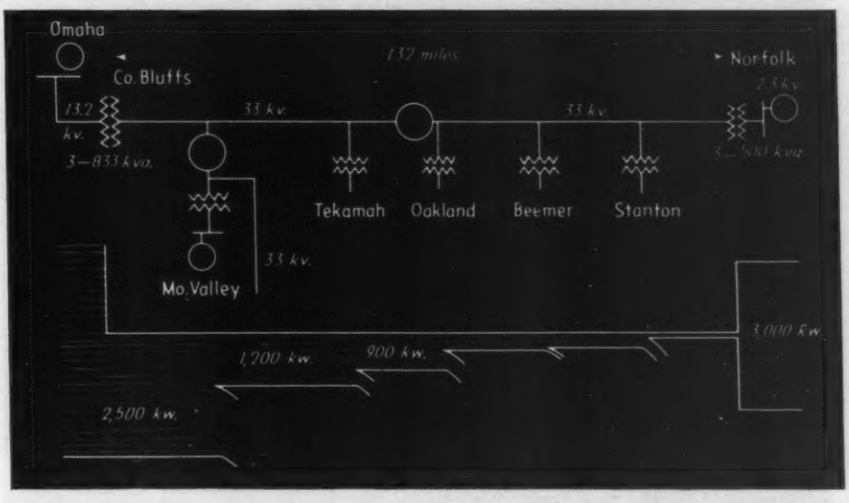
* Three 2-in. conduits with one conductor in each conduit.

Step Regulators for Transmission Control

Two plants with tie line and load take-offs operate satisfactorily by the use of 33-kv. regulator — Theory and practice bring economic results

GLEN C. MOOMAW,* Iowa-Nebraska Light & Power Company

IN THE YEAR 1937 we were faced with the necessity of providing more generating capacity and better voltage regulation to an area served by our Norfolk, Neb., steam plant and the 132-mile transmission line which connects the Norfolk plant with the Nebraska Power Company system in Council Bluffs, Iowa. We looked for an expedient means of increasing the capacity available for the Norfolk territory, something that would tide us over for a few more years, and this caused us to consider a high-voltage step regulator for the transmission line. A step regulator, while it represents considerable investment, is standard equipment which can be moved without heavy loss of investment if the necessity arises.



LAYOUT of transmission lines and regulators with normal power loads

Transmission System

The 132-mile transmission line is three-conductor, three-phase, and carries a nominal voltage of 33,000. Beginning at the Nebraska Power Company end of the line, power is generated in Omaha and transmitted to Council Bluffs at 13,200 volts. In Council Bluffs a bank of three 833-kva. transformers step up the voltage to 33,000 for transmission to Missouri Valley, Iowa and Norfolk, Neb. The line conductor is No. 2 copper from Council Bluffs to Tekamah Neb., a distance of 51.5 miles; thence from Tekamah to Norfolk, a distance of 81.5 miles, the conductor is No. 4 copper. At Norfolk the voltage is stepped down to 2,300 volts through a bank of three 500-kva. transformers.

Load is distributed along the transmission line from several substation points, namely: Missouri Valley, Iowa, where nearly 1,500 kw. may be taken off; Tekamah, Neb., where 300 kw. is taken off; Oakland, Neb., 350 kw.; Beemer, 30 or 40 kw., and Stanton, 250 or 300 kw. Thus, under normal conditions, the load distribution may be as shown in the illustration, with 2,500 kw. flowing from Council Bluffs to Missouri Valley and approximately zero arriving at Norfolk, where the 3,000-kw. load of that area is carried by the Norfolk plant. The Norfolk plant operates in parallel with the Omaha plant and serves to regulate voltage to the substations on the transmission line which may be supplied with energy from Council Bluffs.

Generation and voltage requirements in the Norfolk area are, for the most part, supplied by the Norfolk plant. In times of emergency the Norfolk plant may supply energy to the Missouri Valley district, but never to Council Bluffs, because the contract with Nebraska Power Company provides for purchase only. Thus, although the transmission line is normally used to carry energy from Council Bluffs to the Norfolk substation, it is frequently required to furnish energy beyond the Norfolk substation, and occasionally the power flow may be reversed, with Norfolk supplying Missouri Valley.

Line Regulation Poor

A steam plant at Missouri Valley operates in the winter time for steam-heating service, generating 200 to 250 kw. At other times the Missouri Valley plant is operated for standby purposes only, with 600 to 800 kw. available.

With this brief description of line

*Paper presented recently at Missouri Valley Association.

constants and load conditions in mind, it can be understood that line regulation is poor, as shown by regulation curves, which, of course, were made from more detailed data. It was decided from the study that was made that a 15 per cent regulator, designed to regulate in both directions, and located at Oakland, Neb., approximately the center of the transmission line, would give the desired results.

Our experience in operating the regulator during the first several months was not satisfactory. Occasionally the regulator would be called upon to boost voltage a little in one direction or the other and it would move over its entire range without satisfying the small demand for higher voltage. At other times it might be found boosting its full range in a direction opposite to the flow of power in the transmission line and the contact-making voltmeter would still be calling for more change. The voltage-boosting effect of the regulator apparently would be used up in overcoming the voltage drop that circulating current produced in the transmission line. In general, operation of the regulator was unstable. The instability can be accounted for by vector analysis of the conditions, but instead of attempting to show this by vectors we will discuss some of the features of the regulator's control and review some of the fundamentals of parallel operation of generators in order to explain the instability.

Regulator Is Automatic

The Oakland regulator is located in an unattended substation and is fully automatic in operation. It is rated 34,500 volts, 449 kva., 50 amp., three-phase, outdoor service, 15 per cent raise and lower in 16 or 32 steps. The three-phase regulator has single-phase control. Since it is designed to regulate voltage in both directions, two potential transformers are necessary. One current transformer suffices. Thus, current and potential from a single phase are available to actuate a power-directional relay. This relay is essentially a watt-hour meter element which is constructed to give maximum torque at unity power factor and will, therefore, change its direction of rotation and its contacts with change of direction of power flow. One contact-making voltmeter is provided which is changed from one P.T. and its compensator to the other P.T. and its compensator according to the direction the power relay is pointing. The compensator boxes have resistance and reactance adjustments to simulate the transmission line constants. A time-delay relay with adjustments from zero to three minutes delays operation of the regulator after the voltmeter calls for a change in position. The time-delay relay prevents unnecessary regulator operations due to momentary swings in voltage.

Located in Tie-line

The regulator is located in the tie-line between two generating stations. Generators operating in parallel must have their voltages matched if circulating current is not to flow between them. In considering the line between Council Bluffs and Norfolk it makes no difference where the voltage inequality is introduced between the generating stations, whether the generator excitation is changed or transformer ratio taps changed, or whether a step regulator is introduced somewhere in the line, the effect as regards setting up circulating currents between the stations is the same. An important point to remember in analyzing this setup is that bus voltages at the two generating stations are maintained at constant values by automatic generator regulators.

First, let us consider current and power-factor conditions without a regulator at Oakland. Under this condition the amount of circulating current, and hence power factor relations, at various points along the line is determined by the setting of transformer taps and the amount of generation at Norfolk, which determines the amount and direction of power flow in the transmission line. With both stations feeding power into the line there is always a point of zero power somewhere between them, and this point may be anywhere between Council Bluffs and Norfolk, or it may be in the Norfolk bus, depending on how much Norfolk generates. It is not possible for Norfolk to control the power factor at various points along the line and still maintain a constant voltage at Norfolk.

Power factor at or near the point of zero power in the line may go through all values of leading and lagging. Power factor at the Council Bluffs end of the line will vary greatly with changes in load, but it is possible to choose a transformer tap setting that will give a high power factor at Council Bluffs for the heavier loads that are drawn from that point. A high power factor at Council Bluffs is desirable because of a demand charge based on kva. By choosing the proper transformer tap the Norfolk station can be forced to take considerable lagging current at times in order to hold up bus voltage at Norfolk, and this in turn raises power factor at Council Bluffs, holds down the kva. demand and prevents voltage at Missouri Valley from dropping too much. Thus, under the condition of no regulator at Oakland, the voltage regulation at Missouri Valley could be held to 5 or 6 per cent.

Now let us consider the regulator in service at Oakland. With eight points movement on each side of neutral, each point will produce a voltage change of approximately 2 volts. With each movement of the regulator there will be a change in circulating current flowing in the line. This circulating current is reactive and will, along with the normal reactive current due to power load, affect the line drop compensator of the regulator. Line drop compensator voltage is subtracted from the voltage that affects the contact-making voltmeter. And in some cases the reactive component of voltage due to circulating current flowing through the compensator will subtract enough voltage from the voltmeter to prevent the voltmeter from changing when the regulator changes position. This is an unstable condition and may cause the regulator to go to full boost without satisfying the voltmeter.

Unstable Operation Experienced

Unstable conditions such as outlined actually happened during our first experiments in operating the regulator. The compensation on the regulator was set to correspond closely with line resistance and reactance. These settings were checked by cutting off first one source of power and then the other and noting voltages delivered by the regulator. Operation of the regulator under these conditions was stable some of the time, but at other times it was unstable and the effects it produced were intolerable. A lot of experimenting was done by reducing the reactive compensation settings, but instability still occurred. Finally, the connec-

tions to the reactive compensation were reversed and small negative setting given them. The resistance was then over-compensated to make up some of the loss of reactive compensation. With these settings any tendency of the regulator to over-run causes circulating current to produce a negative reactive voltage, which cancels a part of the positive resistance compensation voltage and thereby produces equilibrium.

Operation Now Stable

Thus, as the regulator is now adjusted, the operation is stable and the number of points boost is approximately proportional to the power flowing through it. Although the power directional relay has current taps for increasing or decreasing its sensitivity, it is set for its most sensitive condition and less than 10 kw. is required to actuate it. The location of the regulator and the generating schedule of the Norfolk plant is such that the regulator is often the point of zero power. This causes the power-directional relay to swing back and forth and keeps auxiliary relays on the regulator operating a great deal. The only effect of this is to increase maintenance of the auxiliary relays.

The 15 per cent boost of the regulator was not sufficient to take care of Norfolk's needs when the plant was shut down after midnight. For this reason transmission line voltage was raised 5 per cent at Council Bluffs by changing transformer taps. This increase in voltage, along with the 15 per cent available at the Oakland regulator, makes a total of 20 per cent more voltage available for Norfolk. Thus, the transmission line is now being operated at two voltage levels, with the Council Bluffs and 5 per cent higher than the Norfolk end. The compensator boxes have resistance taps for the voltmeter to take care of the 5 per cent difference as the voltmeter is changed from one side of the regulator to the other. With zero power flow at the regulator and normal voltage on the two power station buses, the regulator does not now take a neutral position, but instead takes a position about two points boost toward Missouri Valley.

The wide variation of voltage that the regulator might produce naturally brings up the question of voltage to towns along the transmission line between Council Bluffs and Norfolk.

The largest substation, Missouri Valley, where the load taken off may reach 1,500 kw., suffered an increase in voltage regulation from about 8 per cent to about 10 per cent and it was necessary to purchase and install another high-voltage regulator to correct the condition. This regulator has 12½ per cent boost and is rated 50.2 amp. It is similar to the one at Oakland except that it regulates in one direction only. Full use of the reactive compensation and resistance compensation on this regulator is made to give a very satisfactory voltage curve for the Missouri Valley district and its 27 miles of 33-kv. branch line. The Missouri Valley district has no small regulators.

Operation of this step regulator at Missouri Valley has caused no complications because, thus far, it is operated as a branch line regulator, although there are switching facilities for operating it in the main line if that ever becomes desirable. During the Christmas holiday period the standby steam plant at Missouri Valley was operated a few times, generating about 600 kw. Since this 600 kw. represented about 50 per cent of the load on the regulator, the line drop compensator gave insufficient voltage to the district. The condition was temporary and was taken care of by hand-remote control of the regulator from the switchboard. This forestalled any unstable action the positive reactive compensation might have produced.

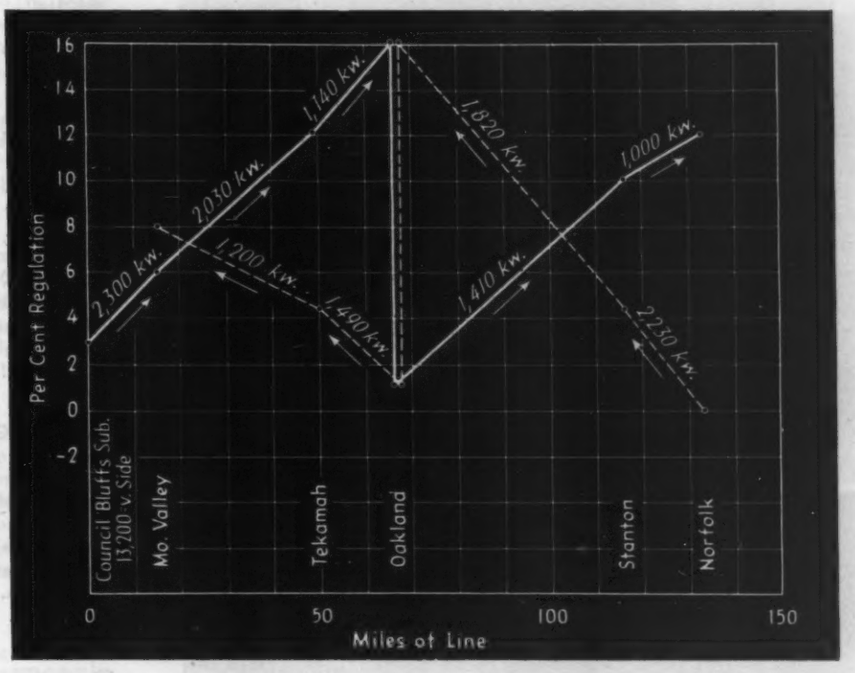
In regard to voltage at other substations along the transmission line, those substations are equipped with lower-voltage regulators.

Effect on Power Factor

Another question may be asked about the effect of the Oakland regulator on the power factor of energy purchased at Council Bluffs, recalling that the demand charge is based on kva. The regulator at Oakland has caused relinquishment of some of the control over this power factor. It is not now possible to use the Norfolk plant to take up excess lagging current in order to hold up the power factor at Council Bluffs, because in order to do that it would be necessary for Norfolk to raise bus voltage and that would be objectionable.

The voltage setting of the contact-making voltmeter on the regulator is critical as regards the power factor that is maintained at Council Bluffs. As the voltmeter setting is raised, voltage to Norfolk is raised and Norfolk generator excitation is lowered, making the Norfolk generator power factor less lagging and making the power factor at Council Bluffs more

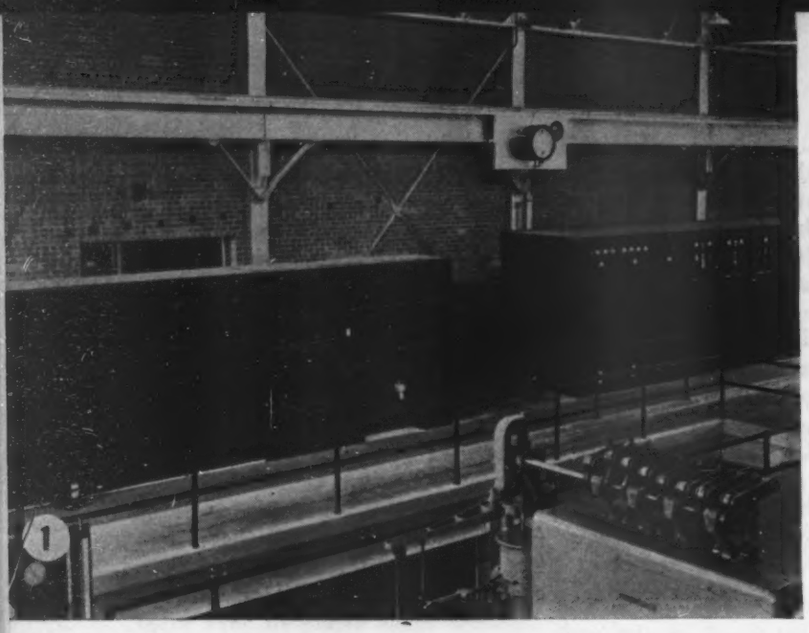
[*Continued on page 60*]



REGULATION of Norfolk-Council Bluffs Line—15 per cent boost at Oakland, 36,000 volts at sender, 92 per cent power factor at normal operation

NEWS-PRINT OF

A. P. SCHNYDER, Electrical Engineer for
George F. Hardy, Consulting Engineer, New York

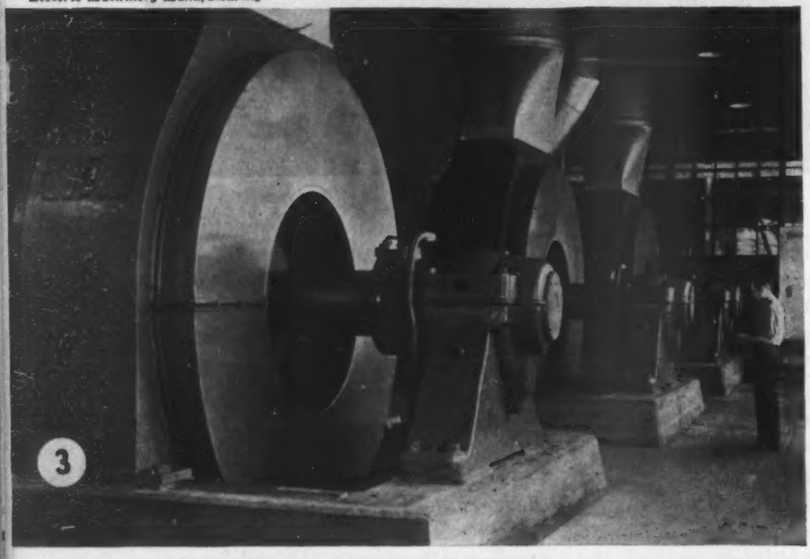


1 SWITCHGEAR controls two 6,000-kw., 0.8-per cent-p.f., 2,300-volt General Electric steam turbine-generators, three 4,000-hp. grinder motors and other mill feeders. (Main switchboard at right, control board at left.) 2,300-volt a.c. is stepped down at four utilization points in the plant by three-phase "Pyranol" transformers to 440 volts. 600-volt d.c. for paper-making machine and 250-volt d.c. for excitation of the synchronous motors is supplied from d.c. switchboards, one in machine room and the other below the main a.c. board. Oil circuit breakers of 150,000-kva. interrupting capacity are used for primary switching; borax fuses furnish back-up protection for 2,300-volt motors—nearly all motors over 100 hp. All motors start across-the-line (Southland is the first mill to have this feature throughout) and there are start-and-stop push-button controls at each motor, with "Deion" breakers to protect the 440-volt motor starters. Lighting is 115 volts; transformers (2,300 to 230/115 volts) supply three to four narrow lighting panels which fit into the vertical steel columns in the plant. Distribution is three-wire. All motor control units have test switch facilities.

Reliance Electric & Engineering

Electric Machinery Manufacturing

2 BARKING DRUM, driven by a 125-hp., 440-volt a.c. motor, revolves at 7½ r.p.m. and removes bark from Southern yellow pine logs hauled to it by motor-driven conveyors. Barked wood is washed, soaked and dumped in wood bins above the grinders; bark is used for fuel. Controls are assembled in small house in right foreground; operation can be supervised and controlled from push buttons in the smaller house above. There are additional individual pushbutton controls locally.

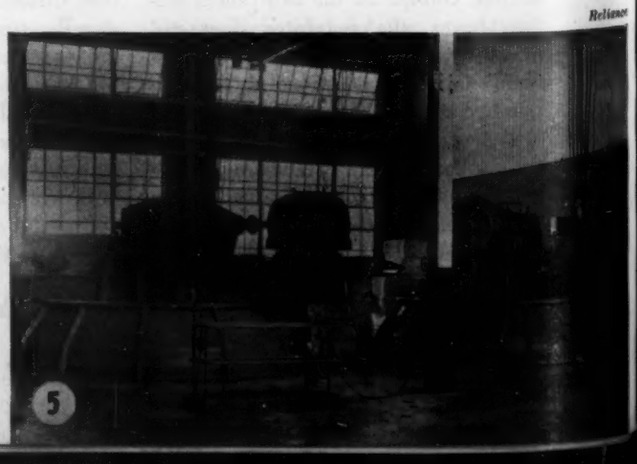


3 GRINDERS, driven by three 4,000-hp., 200-r.p.m. synchronous motors, convert the wood to pulp. Special motors are semi-inclosed, self-ventilated type; cooling air is drawn through openings in the side inclosures and discharged through vents at top of motor. Each motor drives two grinders in tandem; grinders are on other side of wall.

4 PRIMARY PULP SCREENS remove oversize fibres in groundwood pulp from stock troughs before it is dewatered in deckers in foreground and then mixed with sulphate pulp, other ingredient of Southalnd's newsprint. Three screens are each driven by a 60-hp., 1,160-r.p.m. squirrel-cage motor. Ammeter above start-and-stop button serves as operating control by indicating load on motor, hence operating condition of screen.

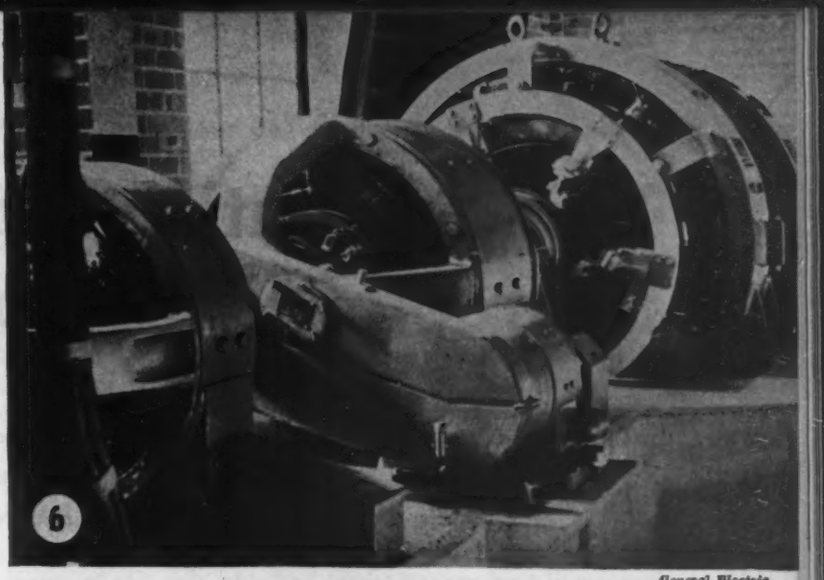
Reliance

Reliance



SOUTHERN PINE

Completely electrified is Southland Paper Mills, Inc., near Lufkin, Tex., first paper mill to make commercial newsprint from Southern yellow pine



General Electric

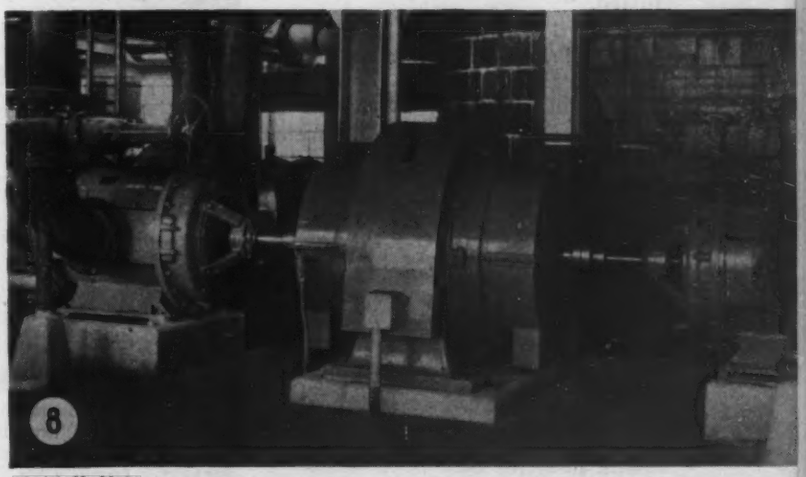
5 SULPHATE BEATERS pound and beat sulphate pulp to pulpy fluid of desired fineness. Two beaters, with combined capacity of 1 ton, are driven by two 150-hp., 1,165-r.p.m. squirrel-cage motors. Proper mixture of wood and sulphate pulp is fed to Fourdrinier wire of paper-making machine.

6 PAPER-MACHINE DRIVE furnishes 600 volts d.c. Motor-generator set includes 1,100-hp., 900-r.p.m., 2,300-volt, 60-cycle synchronous motor; 750-kw., 600-volt main d.c. generator; 200-k.w., 600-volt starting generator; 30-k.w., 250-volt exciter; 20-amp., 1,750-r.p.m. regulating exciter.

Reliance

7 SHAKE HEAD imparts a horizontal motion through an eccentric to frame of paper-making machine as pulp mixture flows along Fourdrinier wire to "mat" the fibres. Driven by 7½/10-hp., 450/1,800-r.p.m. 230-volt d.c. splash-proof motor.

8 VACUUM PUMPS, connected to eight suction boxes two-thirds of the way down the length of the Fourdrinier wire, and the suction couches and presses, draw additional water from the moving and forming sheet of paper. Three 250-hp., 400-r.p.m. splash-proof synchronous motors drive the pumps in the basement below the paper-making machine.

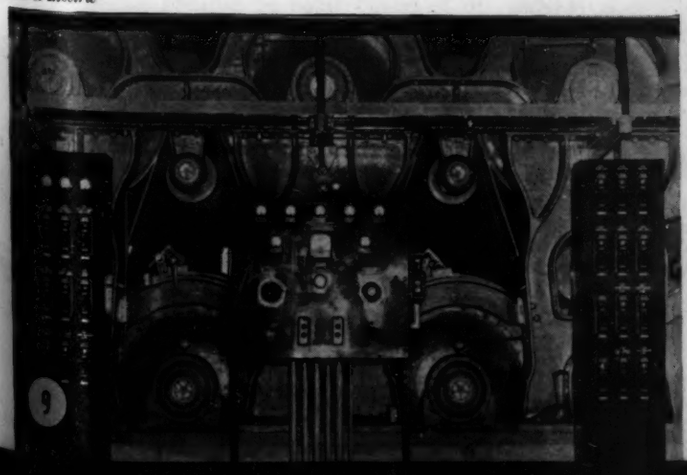


Electric Machinery

9 CONTROL STATION, centrally located along the length of the paper-making machine, enables the machine tender to supervise closely every operation of the machine and its associated auxiliaries. It is one of four stations where equipment is assembled for departmental control.

10 FINISHED PAPER, after receiving proper degree of finish from calender roll, is transferred by electrically driven crane to winder, where entire roll of 234-in. wide paper is rewound and slit to proper width to fit different presses it will be used on. Squirrel-cage, open-type crane motors handle the paper from calender and winder rolls. Battery-operated trucks remove the wrapped rolls to the shipping rooms and stack it for storage until shipment.

General Electric



Reliance

Water Heating Important Source of Utility Income

Potential revenue from electric water heater, incidence of demands and usage on distribution systems and the scope of modern water heating rates presented in N.E.M.A.-E.E.I. prize winning paper

R. E. CAYWOOD and E. E. SPRAGUE, West Penn Power Company, Pittsburgh, Pa.

A COMPETITIVE RATE for water heating does not necessarily mean a rate which gives costs no greater than the cost for other services. There may be other advantages for which a customer is willing to pay a premium. Examples are the well-known advantages of the electric water heater, such as cleanliness, efficiency, convenience, safety, quiet and cool operation—the latter being due to heating units entirely inclosed in the tank—absence of flame and fumes and the use of a small amount of floor space made possible by the characteristics mentioned.

Principal Advantages

The nine principal advantages of water heating load to a utility are as follows:

1. The electric utility company, being an enterprise organized and operated to render a public service, has the duty of making available to its customers any service which it can economically supply. A customer must have what he wants at a reasonable price; *i.e.*, a price consistent with good service for all customers and for all classes of use. Today this complete electric service includes, in addition to lighting and miscellaneous appliance use, the so-called three major services—refrigeration, cooking and water heating. The modern all-electric home is the result.

2. In many locations, especially sparsely settled rural areas, the electric supply is the only utility service available for water heating. Under these conditions the electric company should offer a reasonable water heating rate as a public service.

3. A competitive water heater rate makes the many advantages of the electric water heater available to the home owner.

4. For the customer who heats his house with solid or liquid fuel the electric water heater makes it possible to use only one utility service in the home. This makes for simplicity in operation and maintenance of equipment, subjects the customer to only one minimum charge and requires the payment of only one bill at the end of a month.

5. The electric water heater has become an integral part of the modern electric kitchen. The idea of selling groups of electrical appliances as functional units or "packages" to do a certain job is growing and the complete kitchen package naturally includes the electric water heater.

6. It is highly important, especially in this prolonged period of depression, for every American industry to make new equipment and new services available to the consuming public. The promotion and sale of new ideas puts men to work and builds another step in the road to recovery. Progress is possible only on such a basis.

7. From the standpoint of the conservation of natural resources, the heating of water by electricity is more desirable than the use of oil or natural gas. It is estimated that the coal reserves in the country will last many times as long as the supply of natural gas and oil. Water power is inexhaustible. Therefore, by heating water electrically with energy generated by coal or falling water, natural resources are conserved to the greatest possible degree.

8. Where electricity can be used for all home services except house heating the electric utility's domestic load is protected against the wasteful inroads of competition. For example, where gas is used for water heating there is the possibility that the customer might use this service for cooking and refrigeration as well. This would leave only the supply of lighting and small appliance use by the electric company. Small loads of this kind are costly to serve because of relatively fixed expenses, such as service drop, metering and billing. Low electric rates are made possible by volume business, but the latter is not obtainable where competitive services are substituted for part of the heavy-duty electric load. It should be borne in mind that electric service is required in any home for lighting and small appliances and thus cannot be replaced completely by other services.

9. This matter of low electric rates brings up the question of the water heater load which is discussed in the second part of this paper. The water heater load is advantageous in that it makes for lower rates for other classes of service. The electric utility industry is inherently a high-investment business. This characteristic makes what is technically known as "load factor" or "use factor"—i.e., the number of hours which a customer uses his equipment during a specific period—much more important than for any other businesses. This condition makes it highly important to develop a balanced load to procure the greatest possible use of facilities and thus keep the cost of service at a minimum. Valleys in the load curve at night and on week-ends, as well as during miscellaneous shorter periods, can be filled for maximum over-all benefits.

A competitive water heater rate would very likely be based on the controlled-hour operation or incremental costs. Under controlled-hour operation service is rendered only during periods when certain generating, transmission and distribution equipment is not being used for other loads, and thus a large part of the usual cost of rendering service is avoided. The second type of rate may be based on incremental costs, with no limitation as to hours of usage, the incremental cost representing the additional expense to which the utility is subjected as the result of rendering this service. Either of the above rates becomes a class rate when service is limited to the supply of water heaters.

Class Rates

A class rate based on controlled operation or incremental costs might at first glance appear to be discriminatory; however, the idea is perfectly sound and works to the advantage of all customers, as well as to the other interested parties, namely, utility em-

ployees and investors. Obviously, a competitive rate is necessary to sell electric water heating service; *i.e.*, competitive from the standpoint of price plus intangible advantages as described above. Where, because of the prevailing prices of competitive fuels, it is found that a class rate based on controlled hours or incremental costs must be resorted to, the special rate must cover all "out-of-pocket" costs and contribute something toward meeting general overhead and joint costs of the company. It is this contribution which advantageously affects all of the

E. E. Sprague (above) and R. E. Caywood (right) of research department, West Penn Power Company, authors of first-prize paper awarded $300 by Modern Kitchen Bureau.

customers, in that rates for other services can be lower by the amount of the contribution. The over-all result is that the company's volume of business is increased, with all of the attendant advantages of greater sales of service, and all rates can be reduced because of some coverage of general expenses and joint costs by the water heating customers.

Water Heater Load

Many factors combine to make the water heater load most desirable. One of the principal factors is the size of the individual water heater consumption. The installation of a water heater results in approximately quadrupling the energy consumption of the average residential user. Probably no other residential load presents such possibilities for increasing energy consumption. Even if only a small percentage of the residential users install water heaters, the residential consumption and revenue can be very materially increased.

Servicing Cost

Not only is the water heater load very large, but it is a favorable one from the standpoint of the cost of servicing. It is the one residential load that provides possibilities for largely controlling the time in the day at which it occurs. Thus this load can largely be made to fit into off-peak periods or can be almost uniformly distributed throughout the day. The manner in which it is desirable to con-

trol this load depends upon the characteristics of the system load of the individual utility. Generally it is found most satisfactory to employ off-peak charging periods of from ten to eighteen hours.

In all cases the increase in demand, if any, upon the various classes of facilities employed in supplying the water heater load is comparatively small in relation to the amount of energy supplied. Thus the cost of serving the water heater load consists mainly of the additional costs of generating energy during off-peak periods, together with the allowance for line losses, the cost of special facilities installed upon the customers' premises for controlling and metering the water heater consumption and the additional commercial, new business and general costs involved. Inasmuch as the off-peak generating costs are but little higher than the fuel costs at the more efficient stations available during the off-peak portions of the day, it is evident that the over-all costs of serving the water heater load cannot be very large in comparison with the cost of serving other components of the residential load.

Low Added Costs

Even where the water heater load cannot be fitted in entirely as an off-peak load, or where the water heater is operated uncontrolled, in order to avoid the cost of providing the time switch, the resulting water heater load is an unusually favorable one. Inasmuch as the capacity of the service drop and secondaries are in practically all cases determined by the range demands, additional customer peaks created by the water heater load in many cases involve increased costs only in connection with distribution transformers. Of course, where 24-hour charging is employed, or where there is on-peak use of the top heating element, resulting in creating additional peaks at the time of the peak load on distribution lines or at the time of the system peak, some additional investment in distribution primaries and in bulk power supply facilities is involved.

Analysis of Costs

It is really surprising how low the additional costs of providing for these additional demands are when expressed in terms of cost per kilowatt-hour of water heater load. So much of the total cost in serving residential consumers is involved in providing facilities required for the initial service, but which are not increased in capacity or number with additional use, that the cost of providing additional service is in general materially less than the over-all average costs. Naturally the difference in costs is even more striking

when the additional service is that of the water heater load with its favorable characteristics resulting from its susceptibility to control in time of use.

Added vs. Average Costs

A substantial difference between additional costs and average costs occurs in connection with nearly every function involved in the supply of electric service. Because of the increasing size of power-generating units and of the important improvements made in power station design the first costs, operating costs and fuel costs in connection with new stations are materially less than those of existing stations. Thus in this function alone there is a very material difference between present average costs and the costs of providing additional power. While the effects of improvement in transmission and distribution lines and substation design have not been so very important in reducing the costs of additional power supply, the amount of such facilities involved is very much less for an increase in service than for the present service.

There are several reasons why a smaller investment in line and substation facilities is involved in supplying a unit of additional service than is employed per unit of present service. Some of the more important of these reasons are as follows:

1. The cost of the supporting poles represents a large part of line costs, and in many cases where additional lines are employed they can be installed on existing poles, thus reducing the number of poles required per unit of service. This is especially true of distribution primaries. It is very seldom necessary to provide additional poles to accommodate an additional feeder not extending into new territory.

2. Many lines, because of the requirements for mechanical strength, have electrical capacity several times that required to carry existing loads. In such cases additional load can be delivered with no addition in facilities. This is particularly true of distribution primary lines, with the exception of the sections of such lines serving as main feeders.

3. Many lines and units of substation apparatus normally carry little or no load because they serve as spares. In many cases the number of lines or of units of equipment can be increased without the necessity of providing additional spares.

4. In many cases additional service is provided by replacing existing facilities with others of greater capacity. In such cases the unit cost of the larger capacity item is usually much less than that of the item replaced, thus involving a low additional cost per unit of additional capacity.

Not only is the water heater load a highly desirable load in itself, but in some systems it is only by reason of the profits provided by the water heater load that the taking on of range load at properly competitive rates can be justified. In such cases the costs of the higher capacity meter, service drop and secondaries, together with the other increased costs occasioned by the range load, are in excess of the revenue that the range business can be made to yield. However, after the higher capacity facilities are provided, considerable additional load, other than the range load itself, can be accommodated, especially where the load has such favorable characteristics as that of the water heater load. The possibilities of obtaining a substantial profit by acquiring the water heater are such that the company feels justified in taking on range business, which alone would not be remunerative. Thus the water heater load serves as a means of acquiring range load business that could not otherwise be obtained.

In a somewhat similar manner the water heater load also helps to make possible the taking on of residential air conditioning. Although the water heater load remains fairly constant throughout the year, there is some reduction in the warmer summer months. Thus the reduction in water heater requirements comes at the very time that the air conditioning load occurs.

Aids Air Conditioning

Because of the short seasonal duration of air conditioning, the cost of service will be very high, unless it can be made to fit in with some other load, such as water heating. It is very likely that the total water heater load will be such as to largely, if not wholly, accommodate air conditioning in the summertime valley of the water heater load. Since the air-conditioning load can be made to yield a fairly high rate, it will be evident that fairly large possibilities of profit are afforded in this connection.

Step Regulators for Transmission Control

[*Continued from page 55*]

lagging. Therefore, the Oakland contact-making voltmeter is set to give Norfolk a voltage that is just barely satisfactory. This voltage serves all right on off-peak periods when the plant is shut down and tends to keep power factor at Council Bluffs above 90 per cent lagging when the Norfolk plant is operating. Thus, there is probably a little sacrifice in power factor at Council Bluffs due to the operation of the Oakland regulator, but it is not much because power factor is actually running 90 to 96 per cent for the heavier demands.

When the Norfolk plant is shut down the voltage curve of the regulator is not as smooth as it formerly was when the reactive compensation had a positive setting. The adjustment necessary to bring about the stabilization resulted in loss of regulation to some extent. The regulator can be set to give 100 per cent compensation of voltage for load at a given power factor, but when power factor is above that point the regulator will over-compensate and when power factor is below that point the regulator will under-compensate.

Operations of the Oakland regulator are running about 1,000 to 1,100 per week, or averaging one operation for each nine or ten minutes. Operations of the Missouri Valley regulator run about 700 per week. Even though the Oakland regulator is given fifteen seconds time delay, as compared to Missouri Valley's zero time delay, the operations show that there is much greater tendency for the Oakland contact-making voltmeter to call for voltage changes.

Contact Inspection

Contact inspections are recommended after about 75,000 operations. The contacts of the Oakland regulator were inspected once and showed no apparent wear. A light deposit of carbon that had settled out of the oil on the mechanism was easily washed off with a stream of oil. The oil itself was quite clear.

In conclusion, we will say that the Oakland regulator is serving very well the expedient purpose for which it was purchased. But we would like to caution any one who may contemplate installing a regulator in a tie-line between two power stations to give the matter careful study. In regard to an installation like the one-way regulator at Missouri Valley we see no reason why it should not give complete satisfaction.

Electric Radiant Heat vs. Steam Convection

Experiments with electric radiant heating of buildings reveal lower B.t.u. requirements than with steam convection radiators — See feasibility of extending the method to automatic substations and other special applications

DOUGLAS DOW, The Detroit Edison Company*

EXPERIMENTS with electric radiant heating of buildings undertaken by The Detroit Edison Company during the past two heating seasons have led to the following conclusions:

1. Higher B.t.u. requirements existed for rooms heated by steam convection radiators than for similar rooms using electric radiant heaters providing identical comfort conditions, under certain wall and building conditions.

2. The lower B.t.u. requirements for identical comfort with electric radiant heating were due to inherent differences between convection and radiant heating.

3. In spite of savings in B.t.u. requirements for equivalent comfort conditions in buildings having the usual thermal insulation, demand charges, or the average domestic rate encountered, may place electric radiant heating beyond the economical reach of the average potential user.

4. Buildings, or sections of buildings, occupied only intermittently, such as automatic substations, churches, storage warehouses, isolated working spaces, and the like, are possible exceptions due to factors of occupancy that modify the per B.t.u. cost. Convenience, installation cost and speed of providing comfort conditions in these instances are additional factors to be evaluated when determining the over-all economy.

One of the several tests was conducted in two identical abandoned and adjoining boiler rooms that had been converted into salvage shops and were separated by a brick curtain wall. Electric radiant heaters of sufficient capacity to provide a radiation intensity of 20 watts per square foot of floor space were installed in one room, as shown in the accompanying illustration. They were 1,500-watt, 230-volt units radiating 70 per cent of their energy downward, having surface temperatures of approximately 575 deg. F. at rated voltage.

EFFICIENCY AND ADVANTAGES of electric radiant units and steam convection radiators for room heaters compared by Detroit Edison. Radiant heat has advantage on B.t.u. basis

A total of 5,720 sq.ft. of equivalent direct steam radiation was installed in the adjoining room. The capacity of the electric radiant heating installation was based on requirements estimated by an English consultant. The steam radiation was based upon experience in this company with a similar room. A check calculation

* Chief of research.

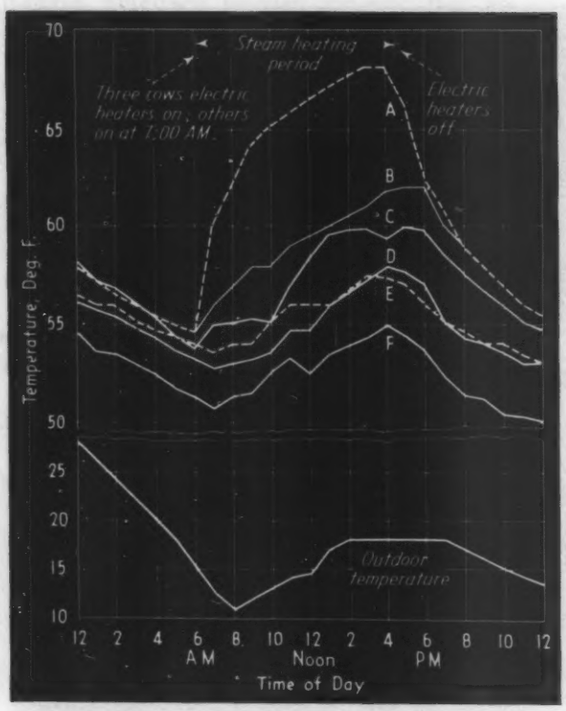
showed that the electric radiant heating installation was sufficient to supply only 30 per cent of the calculated B.t.u. heat loss for its section of the building and the steam radiation was sufficient to supply 55 per cent of the calculated heat loss for its section of the building. Both calculations were made according to standard methods and based upon maintaining 60 deg. F. inside when the outside temperature was zero.

Five recording thermometers in the electrically heated room, six in the steam-heated room at the 4-ft. level above the floor and one in each room at the 62-ft. level were used in conjunction with wet and dry bulb instruments to obtain indoor ambient air temperature records. Outdoor ambient air temperature records were obtained with shielded recording thermometers on the north and south sides of the building. During part of this test a "Yaglou Heated Globe" thermometer was used to determine the equivalent comfort conditions in the two rooms.

Reasons for the higher B.t.u. requirements for the steam-heated room may be deduced from a study of the accompanying curve, which summarizes temperature readings during the coldest test day. The following points are to be noticed from the curve:

1. Rise in temperature recorded at the 62-ft. level in the steam-heated room indicates considerable loss of heat upward. Similar temperature recordings at the 62-ft. level in the electrically heated room indicates comparatively little loss of heat upward.

2. Temperatures recorded at the 4-ft. level in both rooms showed the temperatures in the steam-heated room to be two to three degrees higher than that for the electrically heated room, although reported feeling of comfort and equivalent temperature measurements made with the Yaglou Heated Globe thermometer indicated that the same comfort conditions existed in the two rooms. Heat loss was undoubtedly higher from the steam-heated room due to larger inside-outside temperature differential and the heat flow (loss) upward.



HOURLY TEMPERATURE variation in radiant and steam-heated rooms during coldest day

A Steam-heated room at 62-ft. level; B steam-heated room at 62-ft. level, exposed location; C steam-heated room at 4-ft. level; D electrically heated room at 4-ft. level; E electrically heated room at 62-ft. level; F electrically heated room, unheated section, at 4-ft. level.

Point two above tends to bear out the theoretical reason for the advantage of electric radiant heating from a B.t.u. standpoint. Body comfort depends upon the balance of heat loss from and produced by the body.

In convection heating this balance or comfort is obtained by decreasing the temperature differential between clothing and air, so that less body heat is lost by convection and more by radiation to such of the walls and surroundings as are cooler than the body or air.

In radiant heating this balance or comfort is obtained by heating with radiant heat the clothing, the walls and surroundings, thereby decreasing the radiation losses from the body.

Consequently, in convection heating the ambient air temperature is raised, the clothing-to-air temperature differential decreased and heat is carried upward by convection currents and lost, whereas with radiant heating for the same comfort conditions the ambient air temperature is lower, the clothing-to-air temperature differential being increased. Heat loss from the building is less because of lower temperature differential between indoor-outdoor temperatures.

Because the height of the test rooms and number and arrangement of occupants slightly favor the electric radiant heating system, magnitude of the ratio of B.t.u. requirements for the two rooms might be misleading and are, therefore, withheld by The Detroit Edison Company pending further verification and test.

Adapting 3-Wire Lighting to Network Service

[*Continued from page 52*]

excellent voltage conditions exist throughout the building.

The accompanying illustration shows the new switchboard. Three-pole switches were required for the three-phase power mains as well as for the four-wire lighting risers which were installed to replace the original risers in individual conduits. To carry out the symmetry of the board as well as to provide for possible future load growth, necessitating installation of four-wire lighting mains, three-pole switches were also installed for the present lighting risers utilizing only two of the phases. Both switches and fuses are of sufficient capacity to carry adequately several times present load requirements.

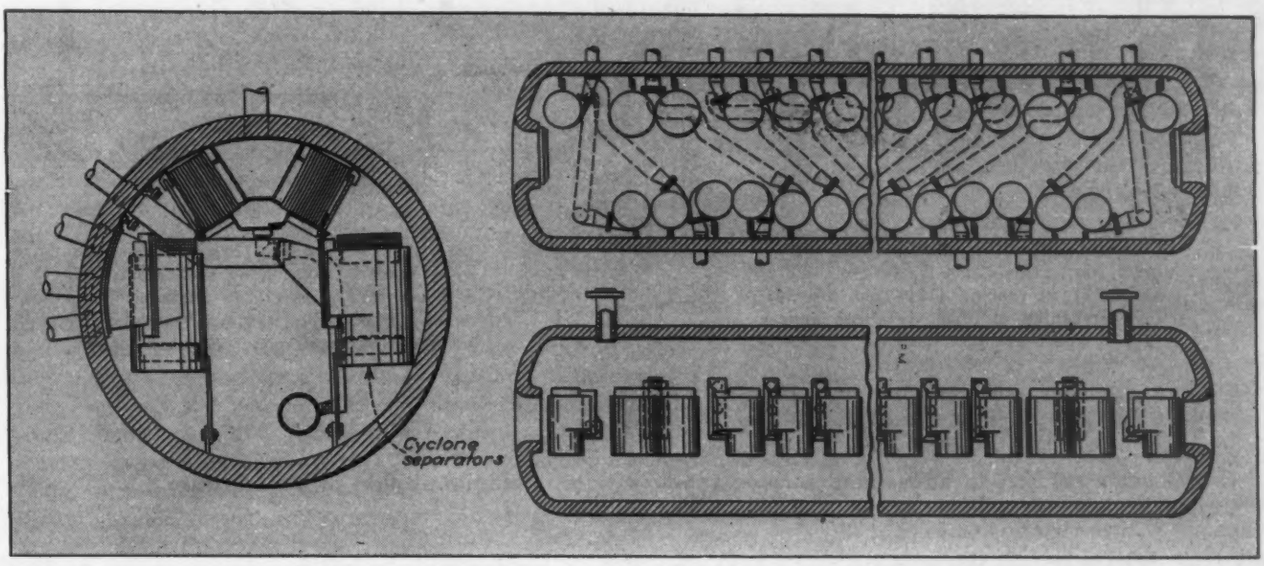
The board is wired symmetrically in that the two switches on each panel are connected in the phase sequence, from left to right, of A,B,C, C,B,A. Fuse positions in the three-pole switches show how the open-Y circuits forming the risers are connected on the three phases to produce a good load balance.

This installation illustrates the possibilities offered in utilizing three-wire mains in buildings connected to the a.c. network system, thereby resulting in definite economies in wiring. However, the limitations of the open-Y circuit must be recognized and attempts to use it indiscriminately can result in very unsatisfactory voltage regulation.

Flexible Steam Provisions for Combination Turbine

Operating either as superposed or condensing unit, new turbo-generator at Walnut station required solutions of special problems in steam and circulating water supply

C. A. BUTLER, JR., United Light & Power Company



NEW CYCLONE SEPARATOR installed in boiler drum

THE 1,350-lb. boiler units in Walnut station are unusual in that this type of design had been used in only one larger installation recently. As stated in a previous article (ELECTRICAL WORLD, July 13, 1940) the two boilers are designed for a maximum drum pressure of 1,475 lb. per sq.in. and are normally operated at 1,350 lb. per sq.in.

The furnace design is of the two-stage type, featuring very high combustion rate in the primary furnace. The primary furnace employs vertical firing and waterwalls completely covered with studs and B&W chrome ore on the furnace side of all side walls, roof, floor and furnace slag screen. The upper half of the screen is completely closed, while the lower half is provided with a number of openings through which the products of combustion and such ash as is not caught and melted down in the primary furnace pass to the secondary furnace.

Secondary furnace walls are made up of bare tubes practically touching with the exception of the hopper portion, which is covered with Bailey smooth blocks, and the upper surface of the furnace slag screen, which is of partially studded tube construction.

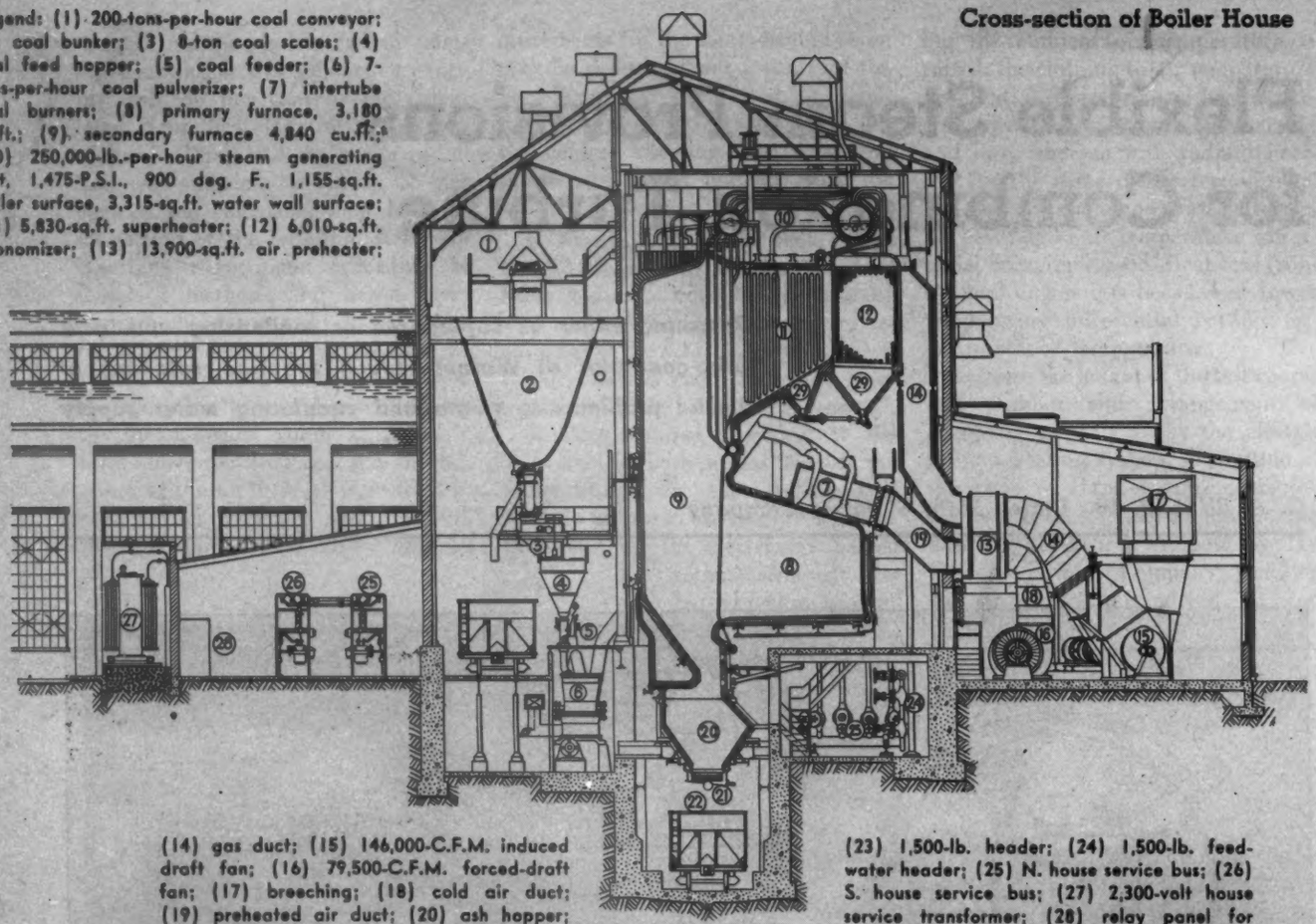
The boiler tank, being vertical, provides the maximum travel of the furnace gases and ash particles before reaching the boiler tubes. This arrangement gives a 180-deg. turn and the boiler tubes cannot "see" the high temperature zone of combustion.

Ash particles, after passing through the screen openings, are immediately screened from the radiant heat of the primary furnace and begin to cool off by radiation to colder furnace wall and boiler tubes so that the ash particle, when it reaches the boiler tube, will be below the sticky stage, thereby preventing serious slagging of the boiler tubes and minimizing the amount of cleaning and lancing required.

The boiler is composed of three transverse drums, with the boiler tube bank in a vertical position. The name "radiant boiler" has been selected for this type of boiler because practically all the boiling or adding of latent heat to the steam is accomplished by radiation into the furnace walls. In fact, there is practically no boiler as the bank of tubes be-

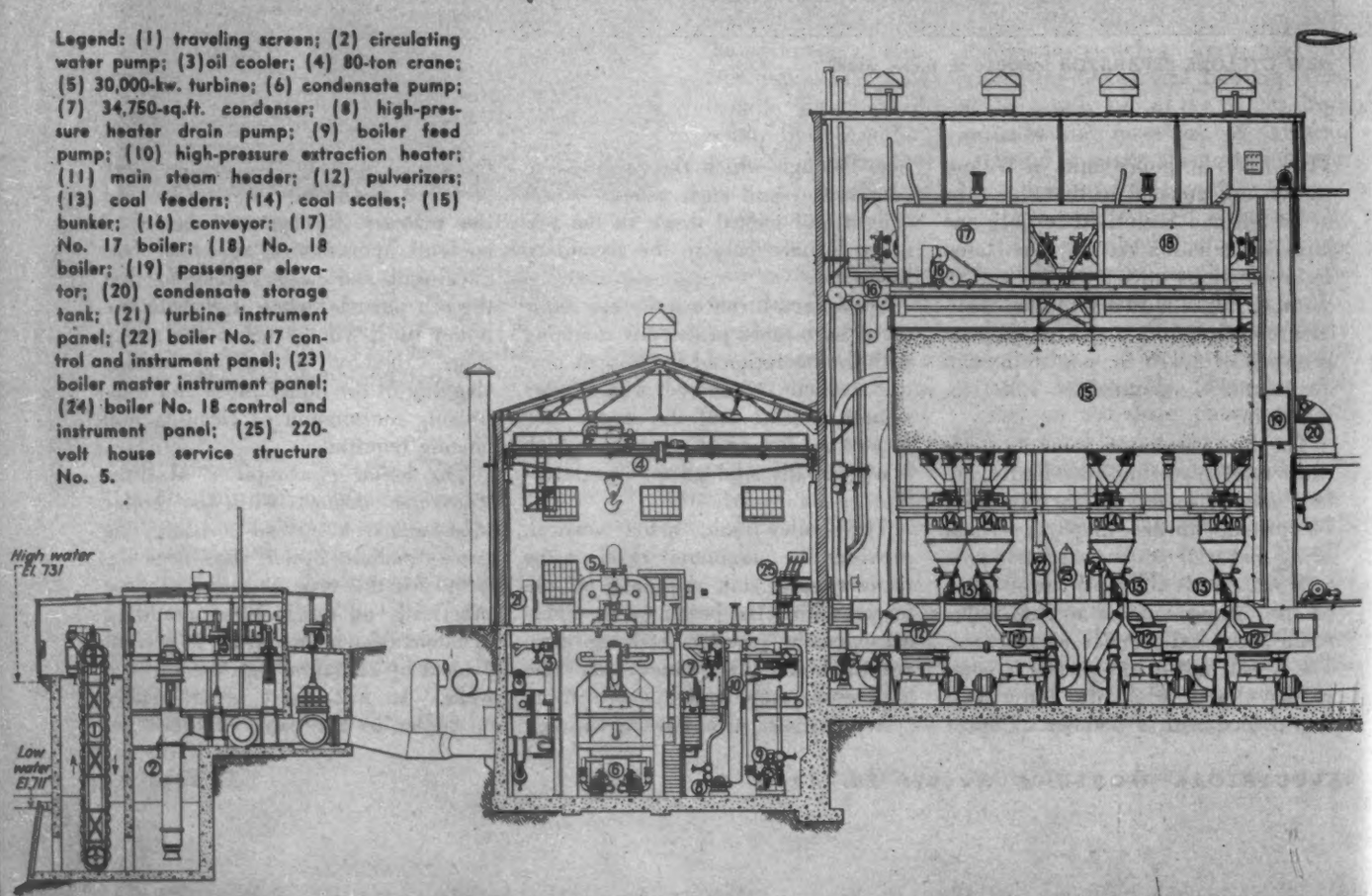
Cross-section of Boiler House

Legend: (1) 200-tons-per-hour coal conveyor; (2) coal bunker; (3) 8-ton coal scales; (4) coal feed hopper; (5) coal feeder; (6) 7-tons-per-hour coal pulverizer; (7) intertube coal burners; (8) primary furnace, 3,180 cu.ft.; (9) secondary furnace 4,840 cu.ft.; (10) 250,000-lb.-per-hour steam generating unit, 1,475-P.S.I., 900 deg. F., 1,155-sq.ft. boiler surface, 3,315-sq.ft. water wall surface; (11) 5,830-sq.ft. superheater; (12) 6,010-sq.ft. economizer; (13) 13,900-sq.ft. air preheater; (14) gas duct; (15) 146,000-C.F.M. induced draft fan; (16) 79,500-C.F.M. forced-draft fan; (17) breeching; (18) cold air duct; (19) preheated air duct; (20) ash hopper; (21) hydraulic ash gate; (22) ash car tunnel; (23) 1,500-lb. header; (24) 1,500-lb. feed-water header; (25) N. house service bus; (26) S. house service bus; (27) 2,300-volt house service transformer; (28) relay panel for house service transformer; (29) soot hoppers.



Cross-section of screen house and turbine room with longitudinal section of boiler house

Legend: (1) traveling screen; (2) circulating water pump; (3) oil cooler; (4) 80-ton crane; (5) 30,000-kw. turbine; (6) condensate pump; (7) 34,750-sq.ft. condenser; (8) high-pressure heater drain pump; (9) boiler feed pump; (10) high-pressure extraction heater; (11) main steam header; (12) pulverizers; (13) coal feeders; (14) coal scales; (15) bunker; (16) conveyor; (17) No. 17 boiler; (18) No. 18 boiler; (19) passenger elevator; (20) condensate storage tank; (21) turbine instrument panel; (22) boiler No. 17 control and instrument panel; (23) boiler master instrument panel; (24) boiler No. 18 control and instrument panel; (25) 220-volt house service structure No. 5.



tween the furnace and the superheater is composed of the risers from a portion of the furnace water walls.

Steam Separation

Relatively large steaming capacity of the boiler per foot of steam drum length, together with the high velocities of the steam and water entering the drums, makes it desirable to separate the steam from the water as the mixture enters the drum, not only to permit fluctuations of water level in the large drum without overloading the steam scrubber, but to improve boiler circulation by making the water entering the downcomers more dense. For this purpose an arrangement of cyclone separators has been installed in the large drum in connection with the steam scrubber, and a similar arrangement but without the scrubber in the small drum.

The maximum moisture content of the steam leaving the scrubber is so low that the solids content is negligible and washing is unnecessary. All water-cooled walls are through-flow circulation without recirculation. Water entering the side and rear walls of the secondary furnace is discharged as water and steam into the rear drum. Water entering the side walls of the primary furnace is discharged as water and steam into both upper drums by means of vertical risers. Water supplying the screen is taken from the same header that supplies the furnace floor tubes and the water and steam from the screen are discharged into the lower boiler drum. A number of downtakes are provided between the main upper drum and the lower boiler drum.

Superheater, Economizer

Purified steam leaves the scrubber and passes through multiple tubes to the superheater inlet header, thence by a series of vertical loops, counter-flow to the gas, to the outlet header. Superheater elements are grouped on one side of the boiler and terminate at a longitudinal baffle which forms a gas bypass for superheat control, which is discussed below. The economizer is made up of a series of loops lying in a horizontal plane and connected at each end to vertical headers.

When starting up the boiler the feedwater is, of course, shut off. Consequently, unless a means of circulation is provided, the water in the economizer tubes is more or less quiet and there is a tendency toward overheating. To prevent this a bypass consisting of a 2-in. tube connecting the water space of the steam drum with the inlet side of the economizer has been installed. This tube acts as a downcomer in a boiler, and as the water in the economizer heats up, it rises to the drum and is replaced with cold water supplied by the bypass. When the feed valve is opened the bypass is shut off.

The economizer consists of a main bank extending across the width of the boiler and a smaller bank extending only across the gas bypass. The longitudinal baffle at one side of the superheater is continued through the economizer.

Superheat control is accomplished by means of two sets of dampers located beyond the economizer in a relatively cool location, one set on the gas bypass side and one set on the main economizer side. On starting up, the damper on the gas bypass side is open and the dampers on the other side closed until the unit is on the line.

Each boiler is fired by two Combustion Engineering Corporation bowl mills, each having a maximum capacity of 14,000 lb. of coal per hour. Continuous record of coal to each mill is obtained by means of a Richardson automatic scale.

Boiler Auxiliary Equipment

Mechanical draft equipment consists of one forced-draft fan and one induced-draft fan for each boiler. Control of each forced-draft fan is by means of inlet vanes and two independent constant-speed motors of different speeds. The blades of the forced-draft fans are backwardly curved to produce a non-overloading power characteristic.

Each induced-draft fan is controlled by means of a variable speed hydraulic coupling driven by two independent motors of different speeds. Each boiler is equipped with complete Hagan air-operated combustion control equipment, which is designed not only to maintain best combustion conditions, but also to operate the dampers which control the superheater to maintain the steam temperature at the superheater outlet at 900 deg. F.

Control of feedwater to each boiler is independent of the combustion control system. The equipment for control of feedwater was manufactured by the Swarthout Company and is of a two-element type which includes an element actuated by steam flow, which aids the usual element actuated by water level in drum in regulating the feedwater flow properly. This feature is of special value in case of sudden fluctuations in boiler load.

Feedwater System

In order to provide best practical feedwater the high-pressure boilers will normally be supplied with nothing but condensate. All of the feedwater for the high-pressure boilers is heated in four closed extraction heaters normally supplied by steam extracted from the new turbine. When the high-pressure boilers are operated without the new turbine the steam for feedwater heating will be supplied by exhaust from a boiler feed pump turbine and by steam from the 250-lb. header.

Due to the expense of building the three higher temperature extraction heaters for full boiler feed pressure, a feedwater system was arranged so that the maximum pressure in the feedwater heaters is 425 to 500 lb. per sq.in.

Deaeration of the feedwater is accomplished in the condenser. In order to keep a constant check on the quality of the feedwater a multi-point conductivity recorder has been installed to record constantly the conductivity of the condensate from each condenser in the plant. If any condenser shows leakage the operation of the system is changed so that condensate from the defective condenser cannot get into the high-pressure boilers. While this system may at first appear to be quite complicated, it has been laid out so that it is self-regulating, even though a minimum of automatic valves are used. No serious difficulties in its operation have developed.

Condensing Equipment

In order to make maximum use of circulating water available a comparatively large condenser of two-pass design, using ¾-in. tubes, was installed under the new turbine. The condenser has a surface of 34,750

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Editorials

S. B. WILLIAMS, *Editor*

Effect of Amortization of Defense Investment on Power Program

ONE OF THE THINGS, and probably the most important, that is holding up the placing of national defense orders is an acceptable policy on amortization of new investment needed solely for munitions production. What effect, if any, will such a policy have upon the power program?

Since it will probably be difficult to set aside any part of generating, transmission or distribution facilities and say that it was definitely required for munitions and had no peace-time usefulness, it would seem that, except in special cases, utilities could hardly expect to find any relief under the provisions as proposed.

It is possible, however, that a policy of amortization that would encourage the building of new munitions plants might soften the demand on utilities for larger blocks of power in that munitions manufacturers could include the necessary power plant in their new investment. In operations where process steam is an important factor this would be especially true. In fact, it is understood that several new smokeless powder plants that will be required to fill the needs of the defense program will in all probability have their own power plants.

Obviously, no utility can foresee where new munitions plants are going to be located, especially when those who are going to own and operate them do not know. For that reason, though there is ample power available in the industrial centers, small companies in remote locations too far from important systems to warrant interconnection are not going to be able suddenly to take on a very large load. Only recently, for instance, a small municipal plant was asked to handle a new load of 30,000 kw., which was nearly three times its entire generating capacity.

If it is necessary to locate a new munitions plant in such a remote non-industrial area, as above cited, that not only does not have the required power and never could have been expected to have provided that much reserve, then the answer would seem to be for the manufacturer to provide his own power. If amortization is permitted he should be able to handle it. The utility, if by chance it could get extra generating capacity in time to serve the load, could not amortize it in five years at a price for energy that the manufacturer would be likely to accept.

From where we sit it does not appear as though this matter of extra investment to serve the purely defense load, except in such instances as just cited, is going to be particularly bothersome to the utilities. When the preparations for defense shall have been completed it is expected there will be an over-reserve of generating capacity. Unless this time coincides with another depression the utilities, in much the same way as they did only a few years ago, should be able to absorb that surplus through load-building drives.

First National Electrical Engineering Equipment Show

ANNOUNCEMENT was made last week of an electrical show to be held in Philadelphia next January at the time of the A.I.E.E. midwinter convention. It is several years since the electrical industry has had a national show, not since the days of the old N.E.L.A., when thousands of people attended the annual convention at Atlantic City. The show proposed for next January, however, will have no appliances, and since it will be restricted to strictly engineering and operating products it will be the first of its kind to be held in the United States.

There are large national engineering shows regularly held by other industries that draw a large attendance, notably the Road Show, Power Show, Chemical Exposition and Machine Tool Builders Show. A number of local shows, principally of industrial electrical products, and held under the auspices of local electrical leagues, have been very successful. It is judging from such experiences, as well as from a recent survey of electrical engineers with respect to a proposed national show, that one has little hesitancy in predicting that the Philadelphia exposition will attract a large and representative attendance.

Turbine Production Well in Hand

CAPACITY for manufacturing steam turbines is largely taken up until some time in 1942. There should be enough capacity, however, to take care of both land and navy orders provided we do not attempt to build a two-ocean navy and provided industry, both manufacturing and utility, uses judgment in placing orders.

Every order for a turbine reserves a certain amount of time in the production schedule. There is just so much time available with present shops. Any orders that are not going to be necessary at the specified delivery date simply delay others that represent more pressing needs.

In the event that we go in for a two-ocean navy, new manufacturing capacity will in all probability have to be built. In the meantime, current orders even in the present volume, can be fitted in without too-long-delayed deliveries.

Although turbine priorities have been discussed, there has been no reason so far to invoke them, nor should that be necessary unless there is a wave of hysteria buying or unless some important communities become pinched for power. Co-operation of buyers, particularly where there are on order a number of units for companies within a group, is expected to alleviate any distress condition.

Considering the avalanche characteristics of the present turbine buying wave, it is remarkable how well the manufacturers are taking care of the situation in an orderly way. There has been a shortage of skilled labor, but long hours at overtime and transference of the better men from other departments have helped to build up the production tempo.

In this connection the buyers also have helped through ordering duplicate machines. Provided no changes are made, this reduces delay to the minimum. No time saving will be made, however, if after placing the order it is decided to change from right to left hand or if other changes which render patterns useless and which require much drafting are necessary.

One Source of Trained Assistance in Regulatory Matters

IT HAS BEEN POINTED OUT on several occasions in these columns that utility executives could, by devoting their time to regular utility operations, leave to specialists those matters of regulation, government reports, hearings, taxation. As a result the suggestion has been made to us that utilities could find such special assistance among the personnel of government agencies engaged in regulation.

This suggestion is not without merit, even though some of these men have not seen eye to eye with utilities in interpretation of the law. The fact remains that administrative perspective on regulation has been undergoing a marked change for several years. Regulatory agencies, being quasi-judicial by nature, have a different approach to the law from the courts, and for that reason develop an opinion not always understood by lawyers trained in ordinary business law. Nevertheless, these opinions when contested are generally sustained.

For that reason men who are trained in the current approach of government agencies to regulation would frequently be in a position to advise utilities better than general business law practitioners. From their experience they would know how far subordinates might go in making demands on the utility and how much was bluff. They might better understand the trend of commission thinking and prepare evidence accordingly.

The employment of these men would be somewhat akin to the employment of tax experts from the revenue office. It is not done to embarrass a government agency, because if it is known that the work is but a pre-business training the government should have no trouble in finding good replacements. Nor is it a matter of trying to evade the law by hiring some one who, because of connections, may be able to squash proceedings.

This is a straightforward suggestion that experts trained in this highly specialized and fast-changing regulatory administration are available and that with their employment there should be less expensive litigation and a little closer understanding between management and regulation.

Effect of Conscription on Electrical Employment

WHILE CONGRESS DEBATES the calling of the National Guard and conscription, every employer and every young man wonders how he will be affected. If, as has been freely predicted, there will be no wholesale exemptions this time, but only deferments based upon consideration of dependency, business disturbance or occupation connected with defense, where does that leave the electrical industry?

While it is too soon to know what the industry will do, certain power company executives have already indicated that unless key men are involved they will make no effort to claim right of deferment.

However, for some time the government has insisted that an adequate power supply was a prime requisite for national defense. Upon that assumption it would be logical to expect that utility men might largely fall in a deferred classification, as well as those working on power supply and distribution equipment for utilities.

On the other hand, an army requires a great many trained electrical men and, as in the last war, these men must come very largely from industry. The difference might be that the Army will be less wasteful this time of special talent and call only such members as are actually required for special work, and not, as in 1917 and 1918, put trained electrical men who enlisted as engineers into almost everything but engineering work.

If those in charge of selection of men for military training will call for only such experience as they have actual need the drain upon utilities and manufacturers will not be nearly as great as it was a quarter of a century ago.

In the hurly-burly of war, when speed is of such great importance, waste of money, equipment and manpower can be expected. In peace-time, however, more considerate action would be expected, with the result that business and essential defense operation should suffer the minimum disturbance.

NEWS OF THE WEEK

Geographical Integration Deferred Until October

Question expected to arise in SEC "blueprints" for four systems or on issue of relevancy raised at future hearings — Cities Service due first

Talk of "arranging" quickly a model case to obtain a definition of the Big B (geographical integration) section of the Holding Company Act is out the window. The issue has been pushed aside for lack of active support and is apparently to be left to come up in the normal course of events, probably in October.

This normal course of events is expected to take one of two turns. SEC may indicate its ideas of what Big B means in releasing its tentative "blueprints" of the four systems which have asked the commission to specify what they should do to meet the "death sentence." Or the issue will inevitably arise, sooner or later, when some system begins offering evidence under the so-called ABC standards of Section 11(b)1 for a second integrated system.

Cities Service First

The latter of these two courses now seems more likely tc be the one adopted. If so, the Big B question can hardly be argued before the commission earlier than October. The case currently most likely to reach this point first is Cities Service, and these hearings are now in recess until September 23.

Testimony on Standard Gas & Electric application to sell its San Diego properties was given the SEC Thursday. This is the first step in Standard's voluntary plan to reduce itself to two systems — Pittsburgh and Wisconsin-Minnesota. But evidence under Section 11(b), scheduled to start at the same time, was delayed again. But for this delay the Standard case might have produced the Big B issue rather promptly.

If the Big B issue is allowed to develop in the normal course of hearings, it will first reach the commission as a matter of procedure. When the first system to complete evidence relating to the ABC standards on its primary operating group begins to offer testimony to prove its right to retain an "additional system" SEC counsel is expected to object on the grounds of relevancy and the objection put before the commission, rather than an examiner, for decision.

First of the SEC "blueprints" is expected to be unveiled within the next week or two, but there remains considerable doubt that the commission will go very far in the way of definite specifications for meeting the "death sentence" requirements. If, for instance, SEC limits itself to identification merely of what integrated systems are controlled by the holding company, the "blueprints" will shed little or no light on the commission's views regarding Big B.

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Philadelphia Electric to Add 80,000 Kw. More

Advance information this week from Philadelphia Electric Co. states that a new 80,000-kw. low-pressure condensing unit has just been ordered for the Chester station. Construction will start in the near future.

Further, in conformance with the company's long-term program, a superposed 50,000-kw. unit at Chester is under construction and is to be completed early next year.

Hawaiian Electric Plans $6,000,000 Construction

Increased power demand caused by expansion of Army and Navy bases in Hawaiian Islands is responsible for a $6,000,000 three-year construction program just announced by the Hawaiian Electric Co., Honolulu, T.H. Major item will be a new generating unit in the company's main steam plant at Honolulu.

Funds for financing the program will be provided through the issuance of $3,000,000 series B 4 per cent bonds and $3,000,000 of series B 5 per cent cumulative preferred stock, both of which have been approved by the territorial utilities commission, but have yet to be approved by stockholders.

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Union Electric Officer Appeals Court Sentence

Frank J. Boehm, who in twenty years rose from a clerk's job at $35 per month to executive vice-president of Union Electric of Missouri at $35,000 per year, this week has filed notice of appeal from his conviction on two counts involving perjury. He had been acquitted by the jury on three other counts.

Counsel for Mr. Boehm allege 34 errors in the complaint as a basis for appeal and also that Mr. Boehm would have been acquitted on all five counts if the court had not issued additional instructions. Mr. Boehm is appealing a $4,000 fine and five-year sentence imposed last week in the U. S. District Court at St. Louis.

F-M Communication for Indianapolis

Frequency modulation radio communication will have its debut in the utility industry late this summer when the Indianapolis Power & Light Company plans to put into operation its new General Electric frequency modulation emergency communications system. Ten of Indianapolis Power's service cars and trucks are being equipped with G.E. 25-watt F-M mobile transmitters and receivers for two-way communication. Though they may be on jobs miles away, these service vehicles will be able to keep in close touch with main headquarters where a G.E. 250-watt station transmitter will be in operation.

The decision of Indianapolis Power & Light officials to turn to the frequency modulation type of transmission in preference to amplitude modulation was made as a result of an investigation of frequency modulation transmission and its capabilities in reducing and almost completely eliminating interference of both man-made and natural origin. They were impressed with F-M's ability to provide excellent reception in areas twice as far from the transmitter as could be obtained with equal-powered A-M equipment.

The 25-watt F-M transmitters for the Indianapolis system will service even a greater area than the best of previous 250-watt amplitude modulated transmitters.

Indianapolis Power officials expect the new communication system will help greatly in handling with swift dispatch any emergency that might arise on the system. In the event a line is down, a life at stake, or other emergency, headquarters will be able to have the nearest truck on the scene without delay. Once there, no longer will it be necessary to hunt for some means of communicating instructions and requests to headquarters for help in handling the emergency. Radio close at hand will do the job.

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Emergency Substation Provided by S. C. Power

South Carolina Power Company has just completed a 3,000-kva. substation and 1½-mile connection to its 44,000-volt transmission system to supply emergency standby service to Charleston Navy Yard.

The substation will be in readiness to supply normal operating needs of the yard in case accident or sabotage interrupted the yard's isolated power plant. A permanent substation is projected for the near future to be rated at 5,000 kva.

F-M ON WHEELS—Frequency-modulation mobile radio equipment, 30-40 MC, 25 watts, to be used by Indianapolis Power & Light this fall. Transmitter at left, receiver at right

Replace Top Men in Associated System

Resignation of Sanford J. Magee, Harry Reid and Henry A. Stix from all executive posts held in the Associated Gas & Electric system has been announced by trustees.

In making public the resignations the trustees issued a statement which pointed out that acceptance of the resignations was not to be construed as reflecting upon "the ability or qualifications of these men.

"They were at the center of previous operations," continues the trustees' statement, "and were in close contact with the previous management. The trustees have felt from the beginning of their efforts that efficiency of operation and the improvement of morale would flow best from a revision of that management."

Mr. Stix was with the Associated system for 20 years, was receiving $30,000 per year, as was Mr. Reid, and Mr. Magee was receiving $36,000 p year.

Mr. Magee's responsibilities for utility operations will be assumed by Alex Speer, formerly with PWA's power projects division and before that with Virginia Public Service and Florida Power Corporation. Co-trustee Denis J. Driscoll will be in charge of rate negotiations.

Mr. Stix's duties are to be assumed by A. F. Tegan, formerly of SEC; E. J. Howe, formerly of TNEC, and L. D. Staver. Mr. Reid, who resigned from Utility Management posts last spring, has now resigned from the presidency of New York State Gas & Electric. Ormrod Titus, executive vice-president of New York State Gas & Electric, who succeeded Mr. Reid on the Utility Management board, will continue in charge of New York State Gas & Electric.

A. E. Throop is taking over the legal work of intermediate holding companies and of certain subsidiaries, assisted by Sam Harris and E. J. Dowling, for merly of SEC, and C. E. Yates, formerly of General Cable. Ben A. Matthews, formerly U. S. District Attorney, engaged in investigating the former management, is assisted by H. A. Blomquist, formerly with a senatorial utility investigating committee.

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Third 230-Kv. River Crossing for Bonneville

Low bidder on the construction of a third 230-kv. transmission line crossing the Columbia River between Bonneville Dam and North Bonneville, Wash., was Fritz Ziebarth, Vancouver, Wash., with an offer of $64,166.40.

The new crossing will be similar to two other structures completed last December (ELECTRICAL WORLD, March 9, 1940, page 67) and will comprise three spans with an over-all length of 4,300 ft. Steel towers will range from 82 ft. to 321 ft. in height and will be equipped with airway beacons. Construction is scheduled for completion within six months after successful bidder receives official notice of award.

FOR FLOATING AIRPORTS—Any body of water of sufficient size can be converted into a seadrome ready for day and night service through the use of these newly developed, remote-control seadrome contact lights developed by Westinghouse. Vice-President Walter Williamson (left) and F. J. Schmidt (right), Wesco, question W. F. White, manager of Westinghouse lighting division

Old Laws Permit Seizure of Plants

Repeal of legislation empowering the Secretary of the Navy to take over and operate private industrial plants needed for national defense work, passed by the House as a rider to the current defense appropriation, has little of direct significance to electric utilities, but is a sign of the times.

The authority had been extended to the Navy secretary in a clause of the so-called Naval speed-up bill passed in June. At the time it was enacted few Congressmen, or any one else, even knew of its existence. Complaints to the defense commission and to Secretary Knox resulted in proposals that the legislation be repealed, to quiet fears that the authority would be abused. House adoption of the suggestion is indicative of the spirit of co-operation currently prevailing in Washington.

From a practical standpoint, the legislation wasn't needed. The President, under 1916 law, still has the right to take over private plants in war or when war is imminent and, more particularly of interest to utilities, the Federal Power Commission has its own emergency power to order plant addition without hearings. Again indicative of the prevailing spirit is the fact that resort to these powers is not seriously contemplated at this time by officials whose advice is being heeded.

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New York PSC Dissolves Walworth Light & Power

New York Public Service Commission has authorized Walworth Light & Power Co. to transfer its works and system to the village of Macedon, which operates a municipal electric plant, for the nominal consideration of $1.

When the Walworth company was organized, in 1923, the village agreed to sell energy to it at cost. Walworth undertook to set aside excess revenue in a fund, and when sufficient money was accumulated to retire the common stock the property was to be turned over to the village without cost.

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Lower Prices Announced by Aluminum Company

In line with the policy of a continuing lower trend in its prices, Aluminum Company of America made another price reduction of 1 cent a pound for aluminum effective August 1. This is the second price change this year. On March 25 the company lowered its price

Sacramento Inaugurates Condemnation Hearings

Condemnation hearings against Pacific Gas & Electric Co. brought by the Sacramento Municipal Utility District were initiated by the California Railroad Commission on July 31. Hearings climax a year of field work by commission engineers in establishing a valuation of the property the district seeks to condemn.

C. T. Mess, valuation engineer, presented a report on the reproduction cost new of the company's distribution system sought for purchase in a 600-square mile area. Total value on this basis was given as $9,419,489. Later reports will cover depreciation, severance damages and the value of additions and betterments since May 21, 1938, the date on which the study was based. All findings of the commission are subject to question by either the district or the company. It is estimated that the proceedings will take several months to conclude.

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Drops Check-off Demand

William Sentner, general vice-president of the United Electrical, Radio & Machine Workers of America, CIO affiliate, has informed ELECTRICAL WORLD that the union had withdrawn its demands for a check-off for a union shop in the strike against Century Electric Co. in St. Louis. Mr. Sentner said that this is the second strike against the company under CIO auspices and only the fifth labor dispute affecting the company in the last 34 years. AFL unions were involved in the three other disputes.

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Illinois Utilities Get Approval for New Lines

Certificates authorizing construction and operation of 277 miles of rural lines in 40 counties have been issued to six utilities by the Illinois Commerce Commission.

Of the total, Illinois Northern Utilities Co. will build 156 miles and Public Service Company of Northern Illinois 61 miles.

Central Illinois Public Service was granted a certificate to build and operate approximately 70 miles of 66-kv. transmission line between Paris and Hoopeston, to meet the need for additional capacity in that area. Illinois Iowa Power was granted a certificate to build 2.83 miles of 33-kv. line in Champaign County to connect the company's substation with Central Illinois Public Service at Thomasboro, and also to build 4.6 miles of power line in Tazewell County to be used in connection with rebuilding a transmission line from Powerton to Bloomington.

for aluminum from 20 cents to 19 cents a pound. The reduction, now effective, brings the price down to 18 cents.

In discussing the company's price policy last November, Roy A. Hunt, president of the company, said: "The benefits of research and development, together with expansion of plants and facilities, permit the company to expect lower costs. In line with its expressed policy, it intends to share such economies with the consumers of aluminum."

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Air Conditioning Economy in Two-Building System

A block-long air conditioning system on Broadway from 96th to 97th Streets, in New York City, serving the Riverside and Riviera Theatres, necessitated laying of a special power line for electricity and permits individual control of any section of either of the two buildings. A Carrier centrifugal machine of 214 ton capacity provides cooling for the system.

"This is merely a forerunner of the installations of the future," Dr. Willis H. Carrier said. "It is possible to effect economies in the operation of air-conditioning plants similar to this which are impossible in smaller installations."

He pointed out that a system patterned along the same lines as the Riverside and Riviera Theatre plant serves air conditioning at the New York World's Fair to both the Carrier "Igloo of Tomorrow" and the adjacent du Pont Exhibit. Rockefeller Center's huge air-conditioning system was also cited as an example of the coming trend in central plant installations by Dr. Carrier.

The system just completed for Skouras Theatre Corporation at the Riverside and Riviera Theatres provides a complete change of air every 30 seconds.

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Iowa Franchise Renewed

Central States Electric Co. of Cedar Rapids, Iowa, has been granted a 20-year renewal of its franchise in Belmond. An article appearing on page 20 of the July 20 issue of ELECTRICAL WORLD implied that the franchise was granted in Cedar Rapids, where Central States does not operate.

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Coulee 95% Complete

Grand Coulee Dam in Washington is about 95 per cent complete, the contractors stated recently. Construction started in 1933 on the $126,000,000 project.

Buffalo Stages Summer Campaign on Roasters

Activity revolves about roaster cooking schools in ten community theaters — 17,000 people attracted to demonstrations — Theaters, department stores, jobbers, dealers and utility merge efforts

Because the electric roaster is becoming an important item in the line of the electrical appliance dealer, the Electrical Association of the Niagara Frontier, of which Merrill E. Skinner is president, this summer gave the appliance a most extensive promotion campaign.

Spearheading the drive was a series of ten Electric Roaster Cooking Schools in Buffalo community theaters, where more than 17,000 people got a 20-minute sales talk on electric roasters in the guise of a radio broadcast.

The association put large posters in the theaters two weeks in advance of the school, advertising its coming and the fact that prizes would be awarded. A trailer was run in each theater for two weeks in advance of the school. The association ran ads in the community newspapers prior to the school and dealers were encouraged to follow suit. The association's ads merely told about the cooking school, while the dealer's ads emphasized that they had roasters for sale.

Dealers also were furnished with banners for their windows and roaster displays were arranged. In cases where dealers were near the theater in question, sidewalk displays and demonstrations were held. Dealer meetings were held prior to the campaign and jobber-manufacturer salesmen covered all dealer outlets to secure as much co-operation as possible in promotion and cooking demonstrations.

The cooking schools were held during the interval between the two regular evening performances when attendance in the theater was heaviest. Each theater received 10,000 tickets, which were distributed a week to ten days before the cooking demonstration as well as on the school night.

The department stores also aided in the campaign by advertising in the metropolitan papers and putting special emphasis on roaster merchandising. While the campaign was primarily a summer effort, its effects are expected to be felt during the Thanksgiving, Christmas and New Year holiday periods.

The Buffalo Niagara Electric Corporation co-operated with the association in sponsoring the campaign by providing the personnel for the radio skit which took place on the stage of each of the ten theaters.

Door prizes, theater trailers, lobby announcements, radio and newspaper advertising, window and sidewalk displays attract 17,000 people to Buffalo's roaster demonstrations

Spring Lake Locale of I.E.S. Conference

The thirty-fourth Illuminating Engineering Society convention and the National Lighting Sales Conference, now in its sixteenth year, will be held September 9-12 at the Essex and Sussex Hotel, Spring Lake, N. J.

A balanced program of 25 papers is to be presented, embracing not only developments in the field of fluorescent lighting but treating also newer aspects and developments in the incandescent field.

Six general sessions are planned with papers devoted to lighting performance in plastics and diffusing materials, analyses of gaseous discharge sources and design and application of luminaires. Lighting applications as well are to be discussed, particularly in the windowless factory, in the home, the studio, schoolroom and photochemical reproduction processes. One entire session will be devoted to color, planned jointly with the Inter-Society Color Council.

The need for information on the more commercial phases of lighting practice is met by a complete day devoted to papers and discussion on commercial residential and industrial lighting promotional activities. Under the direction of the I.E.S. committee on lighting service eight speakers from utility companies will conduct a symposium on residential lighting sales and summarize fluorescent lighting application experiences. Evaluations of lighting to the utility will be presented, together with a summary of "tomorrow's utility sales."

Following the meetings, plans have been made for a day at the World's Fair in New York with provisions for special courtesies to I.E.S. members at the utility, General Electric and Westinghouse exhibits.

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ALEA at Nela Park

An educational conference will be held at Nela Park, Cleveland, August 15-16, by the American Lighting Equipment Association to acquaint members with the association's new specification-certification program. Several outstanding authorities in lighting, merchandising, design and decoration are on the program.

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Seek Baltimore Rate Cut

Both commercial and domestic users of electricity in Baltimore are making an effort to obtain lower electric rates from the Consolidated Gas, Electric Light & Power Co. of Baltimore as a result of recent action by the FPC. The commission has ordered a reduction of $350,000 in the rates under the contract between Consolidated and Safe Harbor Water Power Corp.

MEETINGS

International Association of Electrical Inspectors—Annual meeting, southwestern section, Santa Barbara, Calif., August 26-30; northwestern section, Great Falls, Mont., September 3-6; southern section, Houston, Tex., September 16-20; western section, Kansas City, Mo., September 23-27; eastern section, New York, N. Y., October 7-11.

American Institute of Electrical Engineers—Pacific Coast convention, Los Angeles, Calif., August 27-30; Middle Eastern district meeting, Cincinnati, Ohio, October 9-11; winter convention, Philadelphia, Pa., January 27-31. H. H. Henline, national secretary, 33 West 39th St., New York, N. Y.

American Society of Agricultural Engineers—North Atlantic section, August 27-30, Orono, Maine; fall meeting, Chicago, December 2-6.

American Society of Mechanical Engineers—Fall meeting, Hotel Davenport, Spokane, Wash., September 3-6; annual meeting, New York, N. Y., December 2-5. C. E. Davies, national secretary, 29 West 39th St., New York, N. Y.

Pennsylvania Electric Association—Annual convention, Bedford Springs Hotel, Bedford, Pa., September 4-6. A. B. Millar, managing director, State Street Bldg., Harrisburg, Pa.

Maryland Utilities Association — Fall convention, George Washington Hotel, Ocean City, Md., September 6-7. G. F. Jones, secretary, Potomac Electric Power Co. Building, Washington, D. C.

Illuminating Engineering Society — Annual meeting. Essex and Sussex Hotel, Spring Lake, N. J., September 9-12. F. G. Horton, executive secretary, 51 Madison Av., New York, N. Y.

Rocky Mountain Electric League—Annual convention, Albuquerque, N. M., September 9-11. George Lewis, Manager, Gas & Electric Building, Denver, Colo.

Wisconsin Utilities Association—Annual convention, accounting section, Lawsonia Hotel, Green Lake, Wis., September 16-17. A. F. Herwig, Executive secretary, 135 West Wells St., Milwaukee, Wis.

Association of Iron and Steel Engineers—National convention, Chicago, Ill., September 24-27. Brent Wiley, managing director, Empire Bldg. Pittsburgh, Pa.

Indiana Electric Association—Annual convention, French Lick, Ind., September 25-27. R. E. Blossom, secretary, 1414 Circle Tower, Indianapolis, Ind.

Empire State Gas and Electric Association—Annual convention, Westchester Country Club, Rye, N. Y., September 26-27. George H. Smith, secretary, Grand Central Terminal, New York, N. Y.

Electrochemical Society—Fall meeting, Ottawa, Canada, October 2-5. Colin, G. Fink, secretary, Columbia University, New York, N. Y.

Edison Electric Institute—Electrical equipment committee, Jefferson Hotel, Richmond, Va., October 7-8; transmission and distribution committee, Henry Grady Hotel, Atlanta, Ga., October 14-16. H. S. Bennion, managing director, 420 Lexington Av., New York, N. Y.

International Municipal Signal Association—Annual meeting, Roosevelt Hotel, Jacksonville, Fla., October 14-17. Irvin Shulsinger, secretary, Eight East 41st St., New York, N. Y.

American Welding Society—Annual meeting in conjunction with the National Metal Exposition, Cleveland, Ohio, October 20-25. Miss M. Kelly, secretary, 29 West 39th St., New York.

National Electrical Contractors Association — Fall meeting, George Washington Hotel, Jacksonville, Fla., October 21-23. L. W. Davis, general manager, 420 Lexington Avenue, New York, N. Y.

National Electrical Wholesalers Association—Semi-Annual convention, Hotel William Penn, Pittsburgh, Pa., October 22-25. E. Donald Tolles, managing director, 165 Broadway, New York, N. Y.

National Electrical Manufacturers Association—Annual meeting, Waldorf-Astoria Hotel, New York, N. Y., October 27-November 1. W. J. Donald, managing director, 155 East 44th St., New York, N. Y.

Buffalo Contest on Air Conditioning

The Air Conditioning Council of Western New York has launched an essay contest which bids fair to stimulate considerable new interest in air conditioning both among shoppers and business establishments and result in load building in the air-conditioning field for the power industry.

The contestant must write an answer to the question "Why Do You Like to Shop in an Air-Conditioned Store?" Fifty-six prizes will be awarded for the best answers to this question. The first prize is $75 in merchandise, which must be purchased in one of the stores participating in the contest. The other prizes also are merchandise purchase certificates. The contest closes October 5. More than 100 Buffalo business establishments which are air conditioned are participating.

Posters announcing the contest have been distributed in these establishments. Twenty-two inches high and fourteen inches wide, the posters point out that this business establishment has installed air conditioning for comfort, efficiency and health by a member of the Air Conditioning Council of Western New York.

Attached to each poster is a pocket which contains entry blanks for the essay contest. And this is the only place where these entry blanks can be obtained. This has particular appeal for the business owners since it brings prospective contest entrants into their establishments.

Assisting in the pre-contest build-up were announcements of the contest three times a week over the Breakfast Club radio program.

Stores used facsimiles of the contest poster in connection with their regular newspaper advertising, focusing greater public attention on the contest. The radio announcements gave names of participating stores, but withheld any details on the application blanks, which had to be secured in the stores themselves.

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TVA Contract Invalid

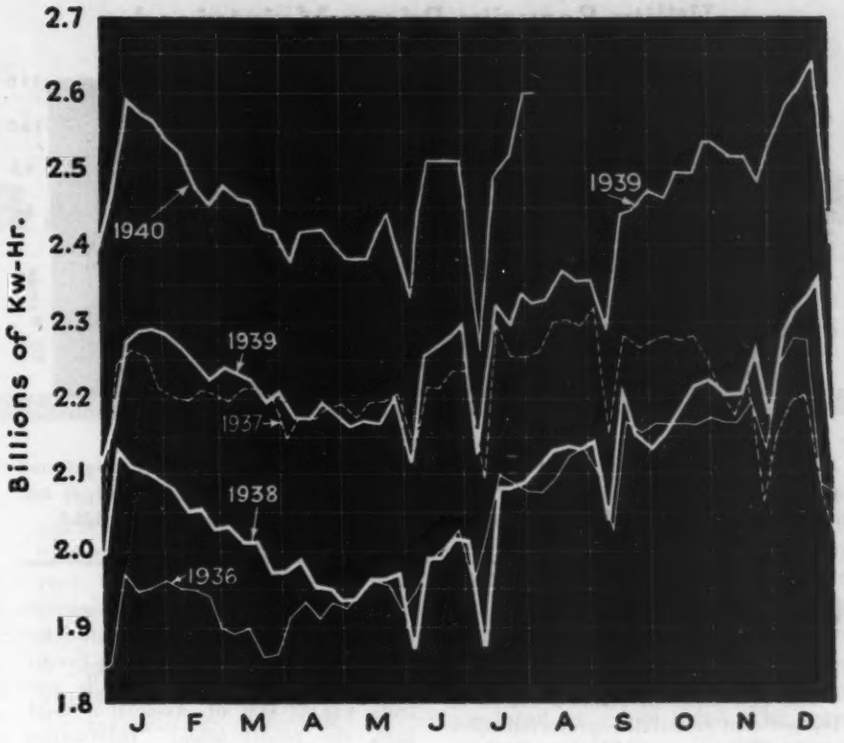
The Court of Appeals, Kentucky's highest tribunal, has upheld invalidation of a proposed contract between the city of Middlesboro and the Tennessee Valley Authority for the city's purchase of electric power. The Appellate Court, affirming the Bell Circuit Court, held that the city failed to comply with laws which require the advertisement of bids before a city may enter into a contract for more than $500.

Moderate Gain in Electricity Output

Production of electricity for the week ended August 3 broke the 1940 record established in the previous week as it rose moderately to 2,604,727,000 kw.-hr., according to the Edison Electric Institute. This output figure was still 1.4 per cent below last winter's all-time peak.

Output for the most recent week was 12.0 per cent above the corresponding week of last year, the largest margin since the week ended January 20. It was 23.2 per cent ahead of 1938 and 15.2 per cent in advance of the corresponding 1937 week.

While the Rocky Mountain and Central Industrial areas still held first and second place, respectively, in point of percentage gains over 1939, the Southern States went into third place with the largest gain for this region over the corresponding week of 1939 since the week ended January 13. Well above the national average for the second consecutive week was the West Central area, where the margin over the previous year was the largest since the week ended August 29, 1936.



Weekly Output Millions Kw.-Hr.

1940		1939		1937	
Aug. 3	2,605	Aug. 5	2,325	Aug. 7	2,262
July 27	2,601	July 29	2,342	July 31	2,256
July 20	2,524	July 22	2,295	July 24	2,259
July 13	2,483	July 15	2,324	July 17	2,298
July 6	2,265	July 8	2,078	July 10	2,096
June 29	2,514	July 1	2,300	July 3	2,238

Per Cent Change from Previous Year

	Week Ending		
	Aug. 13	July 27	July 20
New England	+ 3.4	+ 2.7	+ 5.4
Middle Atlantic	+ 8.0	+ 8.9	+ 9.6
Central Industrial	+17.5	+17.6	+16.8
West Central	+14.9	+11.7	+ 3.9
Southern States	+15.0	+ 8.*	+ 6.5
Rocky Mountain	+21.5	+18.4	+18.1
Pacific	+ 3.7	+ 3.2	+4.4
United States	+12.0	+11.1	+10.0

Electricity Sales Gain 7.3% in Illinois in June

Total sales of electricity to ultimate consumers by the eleven largest Illinois electric utilities during June were 625,-816,915 kw.-hr., a gain of 7.3 per cent over June a year ago, according to the Illinois Commerce Commission. Customers numbered 1,953,763, a gain of 2.6 per cent over June, 1939, and revenue was $13,862,134, an increase of 6.2 per cent, or an average rate of 2.22 cents per kilowatt-hour, as compared with 2.24 cents in June, 1939.

Residential sales in June showed increases of 5.5 per cent in revenue, 6.9 per cent in kilowatt-hour sales and 2.1 per cent in number of customers over a year ago. Rural sales gained 17.5 per cent in revenues, 20.9 per cent in kilowatt-hour sales and 14.2 per cent in customers. Power and other sales in June increased 6.3 per cent in revenue and 7.2 per cent in kilowatt-hour sales over June of last year.

•

Absorbs Defense Tax

D. A. Elias, vice-president of the Pennsylvania Power & Light Co., has assured consumers in the Harrisburg area that this utility will pay the new national defense tax.

•

Output Margin Over '39 Smaller in June

Production of electric energy for public use during June totaled 11,225,620,-000 kw.-hr., an increase of 8.4 per cent over June a year ago, according to the Federal Power Commission. This is the smallest margin over the corresponding month of 1939 for any month of the current year. Production for the twelve months ended June 30 amounted to 135,319,000,000 kw.-hr. This is an increase of 12 per cent over the previous year.

Daily production during June averaged 374,187,000 kw.-hr., or 1.5 per cent more than the average daily output during May. Production by water power in June accounted for 37 per cent of the total for public use, as compared with 40 per cent in May and 36 per cent in June of last year.

Reports received during July indicated that the capacity of generating plants in service on June 30 totaled 40,654,000 kw., a net increase of 8,000 kw. over that previously reported.

Canadian Output Gains 15% in June Over Last Year

Output of central electric stations in Canada during June totaled 2,578,883,-000 kw.-hr., as against 2,671,567,000 kw.-hr. in May and 2,245,537,000 in June, 1939. The Dominion Bureau of Statistics index of power output (1926 equal to 100) stood at 274.24 in June, against 269.67 in May and 238.79 in June, 1939.

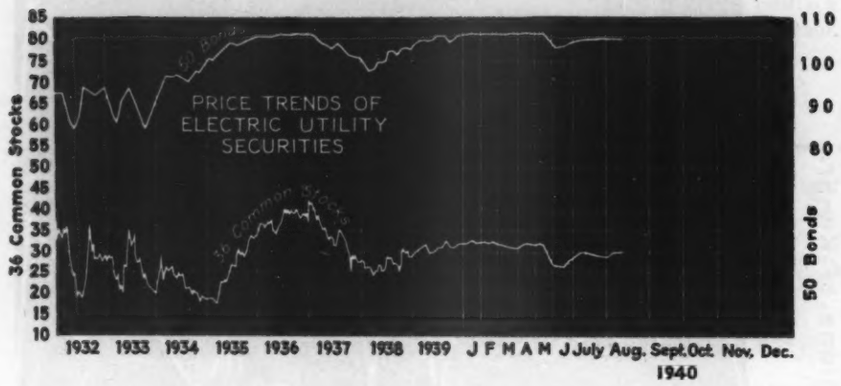
Firm power consumption was 1,860,-736,000 kw.-hr., against 1,941,629,000 kw.-hr., in May and 1,586,964,000 in June last year. Deliveries to electric boilers were 527,443,000 kw.-hr., against 536,585,000 kw.-hr. in May and 495,-510,000 a year ago.

•

New Vancouver Substation

British Columbia Electric Company has filed plans with the city building department for a new substation to be erected at Vancouver, B. C. While actual building operations will involve an outlay of about $14,000, it is understood the equipment planned to be installed will run the aggregate cost considerably higher, probably near $90,-000.

Utility Security Prices Maintained


PRICE TRENDS OF
ELECTRIC UTILITY
SECURITIES
50 Bonds
36 Common Stocks
36 Common Stocks
50 Bonds
1932 1933 1934 1935 1936 1937 1938 1939 J F M A M J July Aug. Sept. Oct. Nov. Dec.
1940

In light trading, the stock list generally eased during the past week. Light and power prices, however, held firm. "Electrical World" stock index remained at last week's level, 29.2; last year, 33.6; bonds also remained unchanged at 105.6

Narragansett Issue Put on Market

The new issue of 180,000 shares of 4½ per cent cumulative preferred stock of the Narragansett Electric Co. was put on the market last week. The stock, with a par value of $50, was priced at $53.25 a share. The issue constitutes the only preferred stock of the company outstanding.

Proceeds of this financing, amounting to $9,231,000 after the cost of issuance, will be used mainly for reimbursement to the company of capital expenditures made out of current funds, and for the repayment of bank loans and open account indebtedness.

Upon completion of the present preferred stock financing, the company's entire capitalization will consist of $33,355,000 of 3½ per cent first mortgage bonds, $9,000,000 of preferred stock, represented by the present issue, and $26,124,350 of common stock represented by 522,487 outstanding shares of $50 par value.

•

Retention of Associated Debentures Advised

Holders of $59,000,000 fixed interest obligations of the Associated Gas & Electric Company were warned by their "general protective committee," to be on guard against reported studied attempts to get them to sell or switch at a time most disadvantageous to them. "While we refrain from making any commitment as to ultimate worth," the report states, "your committee feels that current market prices afford no trustworthy indication of the real value of your securities."

Revealing that the trustees of the billion-dollar public utility system, now under reorganization, "are looking into the circumstances surrounding the formation of the Utility Employees Securities Company," which reportedly controls $35,000,000 of Associated holdings, the report adds: "Information received by this committee would tend to indicate that a direct aim of the old management was to secure ultimate control of these reorganization proceedings, through the device of having the employees, *en masse*, seemingly put in control of large quantities of securities of the top companies, previously held by the public."

•

Detroit Edison Case Based on Control

The declaration by the Securities and Exchange Commission this week that Detroit Edison is a subsidiary of North American is based upon the degree of control exercised by North American rather than upon North American's 19.28 per cent stock ownership. United Light & Power, despite its 20.27 per cent stock ownership in Detroit Edison, was found to have no part in the affairs of Detroit Edison and the latter therefore was not a subsidiary of United.

The decision is not, as claimed in some circles, a new departure by SEC. Instead it is merely spotlighting for the first time the second section of the Holding Company Act definition of the holding company and subsidiary relationship. Heretofore general attention has been focussed upon the 10 per cent clause, which defined a holding company as a company which directly or indirectly controls 10 per cent or more of the outstanding voting securities.

In declaring Detroit Edison a subsidiary of North American, the SEC referred to "the unbroken continuity of North American officers, directors and designees on the Edison Board," the fiscal services rendered to November, 1935, and the establishment of New York offices by Detroit Edison within the North American building.

The action began with the request of Detroit Edison that SEC declare it not a subsidiary of North American, United Light & Power or others. The SEC ruling means Detroit Edison is subject to the Holding Company Act as a subsidiary of a registered holding company and it also means one more problem to be worked out by North American in solving the integration puzzle.

•

Metropolitan Edison to Charge Off $4,444,430

Metropolitan Edison Co. of Reading, Pa., controlled by the Associated system trustees, has filed a notice with the SEC proposing that $4,444,430 of earned surplus deficit be charged off against capital surplus.

•

First Boston Gets Fee

After a series of hearings which began in June, 1939, SEC will permit Indiana & Michigan Electric Company to pay First Boston Corporation $77,344 for its services in a $22,500,000 refunding operation.

•

Allows Board to Intervene

SEC has granted a request of the Pennsylvania Public Utility Commission to intervene as a party to a proceeding in which Metropolitan Edison Co. proposes an accounting reorganization under which an earned surplus deficit of $4,444,430 on June 30 would be charged off against capital surplus.

Utility Reports

	Net Income 1940	1939
*American & Foreign Power and subs	$4,736,065	$5,238,099
*California Oregon Power	950,511	908,474
*Community Public Service	683,823	522,051
*Con. Gas Elec. Lt. & Pwr. (Balti) and sub	6,865,989	6,231,056
*Electric Bond & Share and subs	9,362,830	9,699,954
*Kansas City Power & Light	3,901,594	3,733,473
*Louisville Gas & Electric and subs.	3,005,998	2,673,112
*Niagara Hudson Power and subs.	14,627,140	15,194,520
*Northwestern Electric	549,761	515,550
*Oklahoma Gas & Electric	2,777,938	2,627,039
*Philadelphia Electric	22,502,557	22,274,839
*San Diego Gas & Electric	1,487,774	1,491,694
*Southern California Edison	12,502,732	12,522,260
*Superior Water, Lt. & Power	113,493	111,675

*Twelve months ended June 30.

OPERATING PRACTICES

Compensating for Circulating Current

By B. E. ELLSWORTH
Electrical Engineer, Iowa-Nebraska Light & Power Company, Lincoln, Neb.

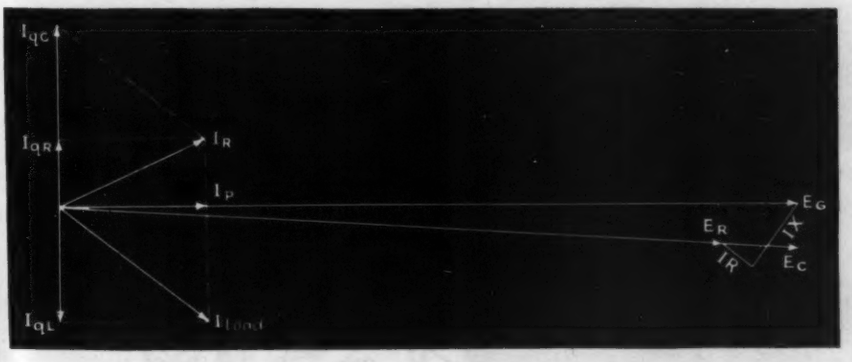
In a line connecting two generating plants current flow may involve in-phase and quadrature currents that often give trouble to control during variable operating conditions. It is usual to depict the actual current at any time as made up of (1) the true power or load current, (2) the load magnetizing current, (3) the synchronizing current between generators and (4) the current set up by any difference that may exist because of different voltage levels at the generating plants or along the line. These vector currents are in phase and in quadrature with the voltage and make possible an analysis whereby operating conditions may be improved.

The relations between these four types of currents in lines between generating stations can best be shown by vectors. Synchronizing surges simply add or subtract from the in-phase current, so they will be neglected.

For example, a plant whose voltage is represented by E_g sends over a tie line to another plant, a load current (I_{load}) at 80 per cent power factor. In the customary way the line drop is laid out and the value of E_r is received at the second plant. The in-phase or power current is I_p and the magnetizing current is: $I_{ql} = \frac{E_g - R_r}{x} - \frac{I_p R}{x}$, where R and x are the resistance and reactance of the line and transformers respectively. If the voltage of the second plant is equal to E_r, then no circulating current due to voltage difference is produced and the tie line acts as a feeder.

If, however, the second plant has a bus voltage also equal to E, then the difference between E_g and E_r or E_c produces a circulating current I_{qc}, which is $I_{qc} = \frac{E_c}{x}$.

This circulating current I_{qc} combines with the load current (I_{load}) to give I_r the resultant current between the plants. I_{qr} is the quadrature current resulting. For the special condition where the bus voltages of the plants are exactly equal $I_{qr} = \frac{I_p R}{x}$.



THE THREE CURRENTS which are present under steady state conditions are, the current representing true power load (I_p), the current representing magnetizing current required by the load (I_{ql}) and the circulating current between plants (I_{qc})

It will be noted that the circulating current due to voltage difference or E_c is opposite in direction to the magnetizing current; therefore, in order to prevent any automatic voltage regulator from going to maximum boost or buck position, the reactance compensation must be reversed and reduced to a low value. The resistance compensation will then have to be increased correspondingly to secure proper voltage from the regulator. Reversed compensation is used to keep circulating currents due to voltage difference at a minimum in plants where generator voltages are compensated, in tie lines having automatic voltage regulation and in network feeders having voltage regulators.

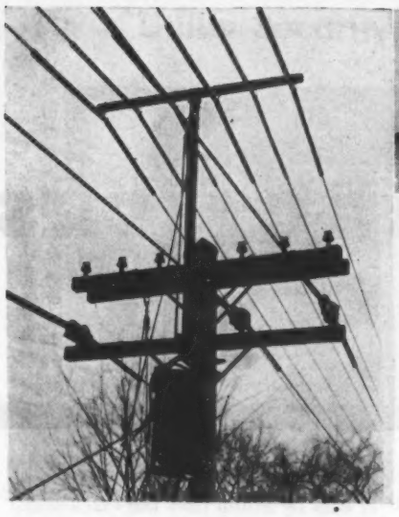
•

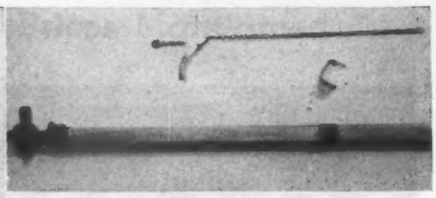
Transformer Gin Lightens Line Work

An improved and "streamlined" transformer gin developed by a general line foreman of the Buffalo Niagara & Eastern Power Corporation is lighter and smaller than the type previously in use and yet it is stronger and easier to install and operate.

The head consists of a roller bearing sheave welded into a steel sleeve which is shrunk on a shaft of select white ash. This provides strong construction without excess metal. A movable band prevents the line from getting off the sheave at the top. Multiple blocks may be used if desired.

For the upper pole fastening either an arm hook or a through-bolt may be used, depending on the desired rigidity. The lower pole fastening consists of a light chain which goes around the pole and clips into a steel





TRANSFORMER GIN—8-ft. pole—detachable arm hook and chain for the bottom fastening; total weight, 39 lb. (above). With addition of temporary crossarm (left), six conductors are supported from top of gin pole until transformer and crossarm changes have been completed

band at the bottom of the shaft.

The chief operating advantage of the new transformer gin over the old type is the fact that the pull line goes up over the top of the sheave and down on the opposite side of the pole. This balances the pull on the shaft and eliminates the hazard of fouling the rigging when the transformer is raised. The previous type gin had the sheave attached to a ring at the top of the shaft; the bending pull was all in one direction and pull line came down in front of transformer.

Another development is a temporary crossarm fastened to the head of the gin. With it as many as six conductors may be raised and supported on adjustable hooks while crossarms are changed and the transformer is raised into place.

•

Installing "Snail" Strain Clamps

Extensive use of high-strength aluminum-steel-core reinforced conductors has resulted in the demand for high-gripping-strength clamps, one type being the "snail" type. Where the conductor first enters the clamp the diameter of the groove is large, but from this point the groove is gradually reduced in size until the clamping section is reached. By this means not only is the traveling wave gradually absorbed in the conductor within the clamp but the conductor is progressively relieved of its tension in the bed of the clamp groove as it approaches the center of the involute where it is finally clamped.

The method described in the *Electrical Review* (British) is that actually employed on 132-kv. lines, where the over-all length of string is considerable and where it is difficult for men on the tower to reach the snail clamp owing to its distance from the crossarm.

The erection diagram shows the situation immediately before the installation of the snail clamp. The conductor is supported by snatch blocks at suspension and tension positions and is terminated at the winch on the ground (the strain string is not yet erected). When the wire is correctly sagged and tensioned it is marked to correspond with a given point on the tower, say the center line, and then the tension is relieved and the conductor brought down to ground level.

A distance "L," which is the over-all length of the strain string from the center line of the tower to the back of the clamp, is measured back along the conductor. If a distance equal to the length of clamp path "l" is measured forward along the conductor a point will be reached corresponding to the outside edge of the bolted clamp plate. This point should be recorded and the conductor, if of steel-cored aluminum, should receive a single wrapping of soft aluminum tape. It is customary to continue the taping for a short distance outside the clamp. If the clamp is rotated the taped conductor will take up its position in the clamp. While the clamp is being hauled into position on the line the conductor should be tied into the clamp to avoid springing out.

•

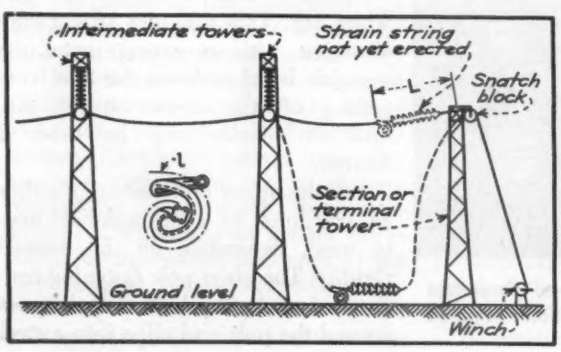
Reverse Power Relay Changes Exciters

By GEO. I. SMITH
Switchboard Operator
Minnesota Power & Light Company, Duluth, Minn.

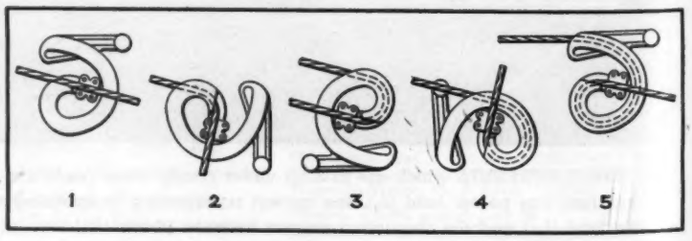
Transferring the excitation load from one exciter to another requires proper voltage adjustment on the two exciters, in order to keep from "motoring" one exciter and throwing an overload on the other. Any overload on an exciter causes a corresponding dip in the voltage of the alternator for which it is supplying the field—a condition switchboard operators try to avoid.

In those generating stations equipped with remote-control exciter switches the possibility of motoring an exciter can be prevented by the use of a reverse-power or reverse-current relay in the circuit of each exciter. These may be connected so that when the direction of flow of current is reversed the relay will open the exciter switch *to which* the current is flowing. There are reverse-power relays on the market which will close contacts on a 2½ per cent reversal of full load rating.

Take, for example, two exciters of



ERECTION PROCEDURE—Five steps showing insertion of conductor in snail clamp



400-amp. rating, with an excitation load of 300 amp., the total load possible for either of the exciters would be the 300-amp. excitation load plus 10 amp. (2½ per cent of 400) going to the "outgoing exciter." When the "outgoing exciter" starts to take 10 amp. as a motor the relay will disconnect it from the exciter bus.

It would be necessary to check for, and possibly correct, the polarity of that exciter, but that would be much better than to have a severe dip in the a.c. voltage, with the possibility of the loss of excitation, as in the case of motor-driven exciters.

•

Checking Transformer Loadings

By S. H. POLLOCK*
Kansas City Power & Light Company

Transformers require considerable testing to prevent their destruction by overloading. We have about 8,800 of them in the Kansas City district, with a replacement value well over a million dollars. Last year we spent $1,989 in testing them, or less than 0.2 of 1 per cent of their value. The tests were made by two men working in a car for two days each week and consisted of 127 tests with the Thermotels at a cost of 59 cents each, 298 tests with Lincoln demand meters at a cost of $1.75 each and 384 tests with graphic ammeters at a cost of $3.63 each. These costs include labor, charts, transportation and meter maintenance by the laboratory.

All meters are allowed to run a full week so as to get the peak day of the week. Thermotels, while economical, do not give very reliable results. We use them only in the summertime as kind of feeler tests. That is, we set lots of Thermotels, and wherever we find one that gives a sufficiently high reading we set one of the other type meters to determine the actual load. The Lincoln demand meters we now think are the ideal way to make transformer checks and we plan to purchase more of them this year to use in place of the twice-as-expensive ammeter tests.

As to the actual economics of this work, last year we made 811 tests and changed 80 transformers. These 80 transformers as found totaled 1,717.5 kva., an average size of 21.5 kva., and were carrying 146 per cent load. After changing, they had a total capacity of 2,987 kva., an average size of 37.3 kva. and were carrying 83.7 per cent of their rating. The present-day price of the 80 transformers that were changed is $12,407.23. Considering that similar savings have been made in each of the past ten years, our transformer testing seems to be paying its own way. A transformer burned up from overload is practically an unknown thing any more, and we are not accomplishing this by over-transforming, because the 811 transformers tested last year showed an average loading of 85.8 per cent. We also made a saving by changing these transformers during regular working hours, and in six instances of three-phase power banks we could not have increased the size of the transformers without building heavier supporting structures.

*Excerpt from recent paper Missouri Valley Electric Association.

•

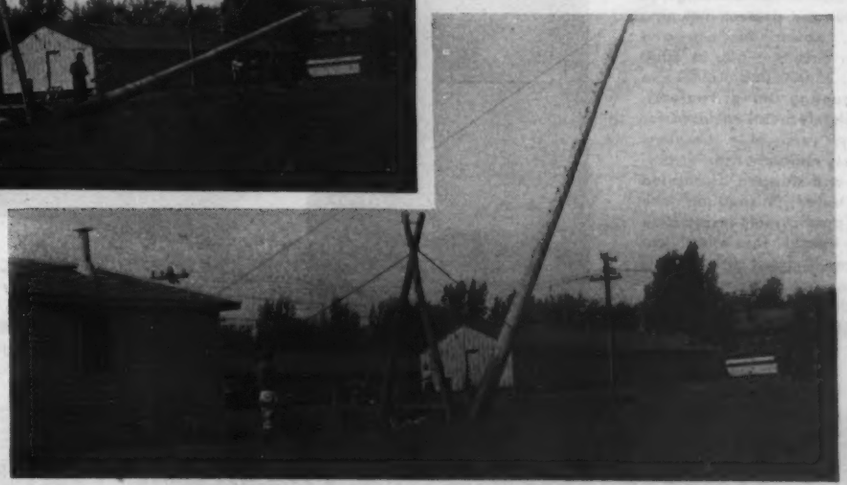
Setting Long Poles by Bull Rope Method

By RAY BLAIN
Washington, D. C.

When it becomes necessary to erect a long, heavy pole and for any reason the conventional methods are not practicable, the bull rope method may often be used to advantage. With this method the butt of the pole must be placed near the hole and the hole should be trenched in the direction in which the pole is to be raised. This trench should be sloped to at least one-third the depth of the hole with a length of at least two-thirds the hole depth. A plank butting board or a digging bar should be placed in the hole for the butt of the pole to slide down on.

With this method the pole can ordinarily be lifted direct from the trailer, if the pole is placed so that the butt lies in the trench and firmly against the butting board. A tree or nearby pole may be used to attach a snatch block for the bull rope support. Two side guys should be placed on the pole, also one rear guy to hold it in position during and after erection.

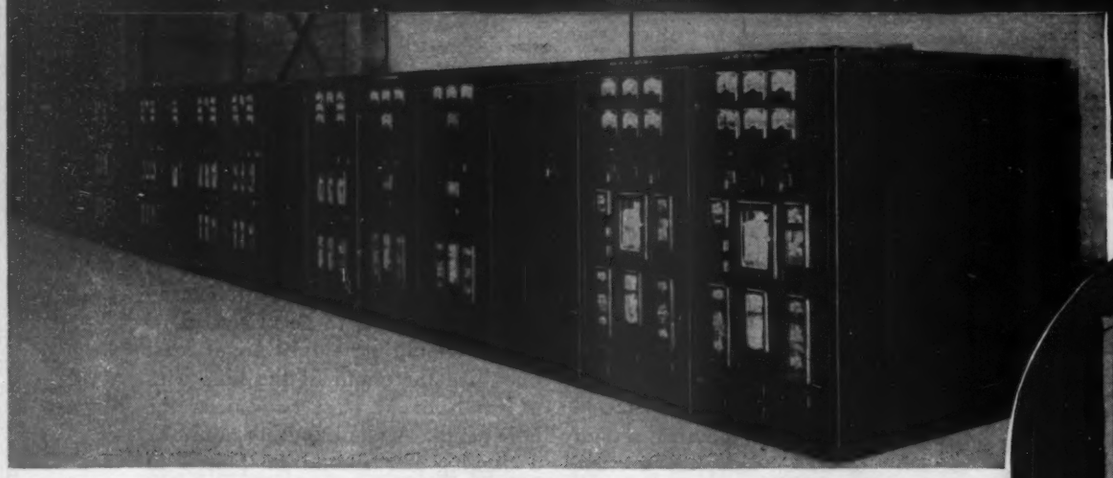
When no support is available two light-weight 20-ft. poles may be lashed together near the top and guyed (as shown) to support the snatch block for the bull rope support. This method may be used for the erection of high and heavy poles (including 100-ft. poles) with safety when trained help is not available.



BULL ROPE METHOD sometimes an advantage in setting long, heavy poles

Above—Pole is in place at the hole, in the trench with bull rope over crossed pole fixture, ready for raising. Right—Pole being raised. Note that bull rope has cleared pole fixtures and that side guys are holding pole in line.

LOOK to Your



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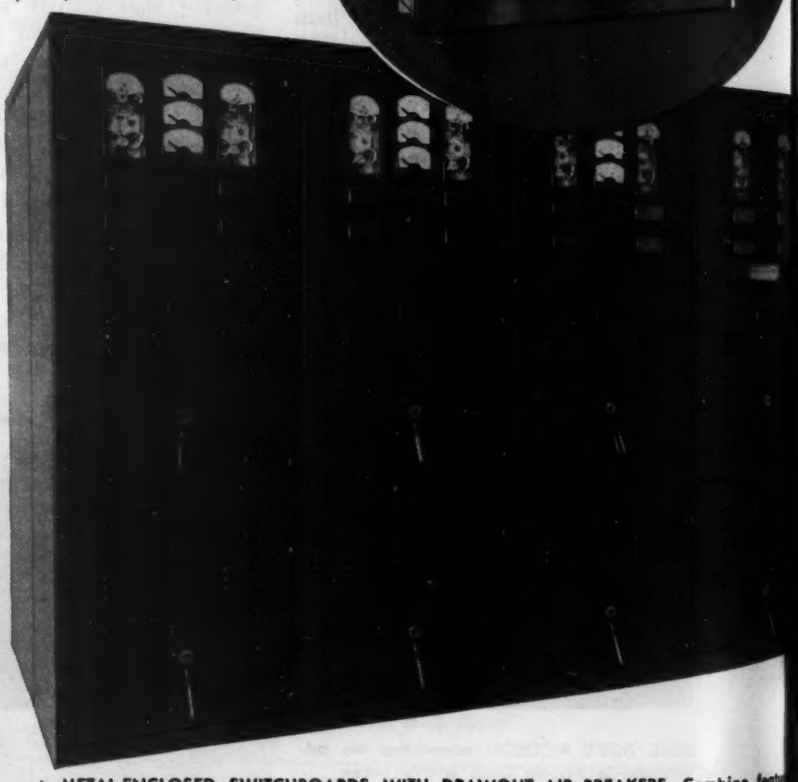
AIR CIRCUIT BREAKERS. To protect low-voltage power-distribution circuits — up to 600 volts, 80,000 amperes interrupting rating. Needed practically everywhere power is used, to open and close circuits, for automatic interruption in case of trouble, and to restore service (a turn of the handle does it). G-E breakers have ample capacity to interrupt heavy short circuits. Trip-free operation provides for safety. Arc quencher assures positive, safe interruption by completely breaking up and confining arc. Now helping to prevent production delays in many plants. ▶



▶ **MIDGET METAL-CLAD.** For general power and lighting service in industrial plants and commercial buildings, to control and protect incoming lines, power feeders, and motor circuits — 600 to 5000 volts, 25,000 and 50,000 kva interrupting rating. Features: completely metal-enclosed for safety; removable breakers — easy maintenance; factory-built and shipped assembled — a tested, finished job with low (predictable) installation cost; liberal insulation; coordinated circuit components; mechanical interlocks; self-contained control. Prices have been drastically reduced.

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—DON'T LET IT BE THE PRODUCTION BOTTLENECK

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...Planning for Increased Production

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Modern G-E switchgear is one of the best types of production insurance you can buy. You need the complete circuit protection which it gives even under the most severe conditions. You need switchgear that will get circuits back into service in the shortest possible time after outages due to short circuits and overloads.

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Avoid the penalty exacted by obsolete switching equipment—the penalty which you pay in the form of lagging production schedules, and in hazards to operators and property. It will pay you—in profits and in peace of mind—to bring your switchgear up-to-date. Act today!

HAVE A CHECKUP MADE NOW

Why gamble with obsolete switchgear? If your equipment is 15 or 20 years old, the actual protection it affords may be less than you suspect. It may subject your operations to penalties—delayed production, hazards to machinery and personnel—that can undermine the profits of the most efficiently run production department.

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General Electric, Schenectady, N. Y.

GENERAL ELECTRIC

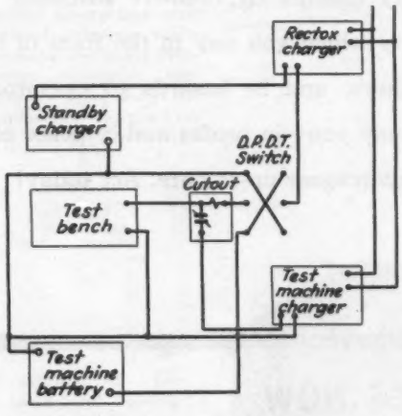
854-1

INDUSTRIAL ENGINEERING

Boosting Capacity of a Magnetic Test Set

By EARL B. ANKENMAN
Westinghouse Electric & Manufacturing Company, Boston, Mass.

"The best laid schemes of mice and men gang aft agley" is proved time and again in many industrial plants. Apparatus having a capacity well above the normal demand and equal to the expected load when purchased is often inadequate for every-day production when manufacturing processes change.



CONNECTIONS of completed layout for magnet test bench

Such was the case recently experienced on a magnet-testing bench. When the bench was originally installed all the testing could easily be taken care of in an eight-hour shift. Improved business conditions and a greater variety of articles coming to the bench resulted in a test load large enough to keep the bench busy 24 hours per day and six days per week. The bench capacity was sufficient to take care of the load when operated continuously, but the source of magnetizing current was insufficient. The problem was solved by adding a spare set of batteries and a "Rectox" charger.

Originally the test bench was provided with a bulb type rectifier for charging the set of magnetizing batteries. When the bench was being loaded or unloaded the rectifier charger was in operation, replacing the energy drained from the batteries on the previous test cycle. With normal load and an eight-hour day the battery was kept at full charge. The extra load and increased operating time soon discharged the battery faster than it could be charged.

Standby Provision

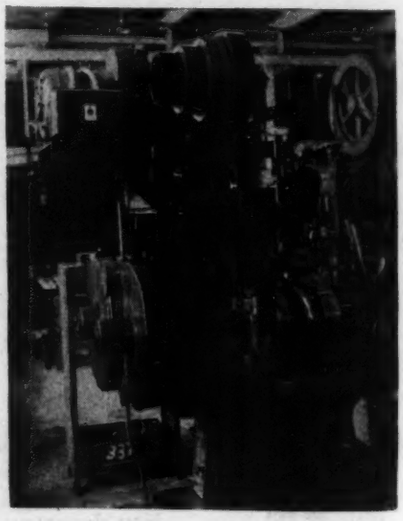
The bench was designed so that during the actual test cycle the charger was automatically disconnected from the battery to eliminate charger overloads. To increase the capacity of the bench it was only necessary to install a standby battery and a means of charging it. In order to obtain sufficient use of this extra equipment it was desirable to arrange the connections so that either battery could be used on the bench test and the other connected to the standby charger.

The test bench was located where space was limited. The extra charger supplied was a forced ventilated plate type "Rectox" with a charging capacity of 30 amp. It was mounted on the wall across the aisle from the charger high enough to be out of the way. Directly below it a standard battery rack modified to meet the requirements was set on the floor next the wall. The modifications of the rack consisted of busbars mounted above each shelf of the battery rack, and a 400-amp., two-pole knife switch mounted on the end of the rack. Six standard three-cell batteries were connected to the buses to form the composite spare battery.

•

Convert Bolt Cutter to Individual Drive

In transferring a National duplex bolt cutter and threading machine from an old plant to a new shop a New England establishment included this in the salvage of some half hundred machine tools formerly belt-driven in groups and still in good enough condition to operate for an indefinite further period. This unit was provided in the new location with a step pulley main drive as before, but in place of the former line shafting connection a second step pulley



WELDED FRAME supports motor, starter and step pulleys

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SMALL DIAMETER BUILDING WIRE

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BY THE UNDERWRITERS' LABORATORIES

Flamenol Small Diameter Building Wire, Type SN, insulated with plasticized polyvinyl chloride compound, is approved in all sizes from No. 14 to 4/0 inclusive. (Label Service—Guide Card 400—119Y—File E13268)

FLAMENOL HAS MANY ADVANTAGES

1. Existing buildings can be rewired inexpensively with this wire because new raceways aren't necessary. Simply replace existing wires in raceways with Flamenol.
2. Flamenol Small Diameter Building Wire is easy to handle. It has a smooth, glossy wax finish. It is easy to strip and to pull. Moreover, this wire is available in many bright, clear colors which make circuit identification and testing easy.
3. Flamenol Small Diameter Building Wire can be depended upon to give good service. Its insulation is superaging, high in dielectric and mechanical strength, flame retarding and resistant to moisture, oil, acids, etc.

For further information or samples, see the nearest G-E Merchandise Distributor or mail the coupon at right.

Reg. U. S. Pat. Off.

COMPARISON OF WIRE DIMENSIONS

Size AWG	Approximate Over-all Diameter (In.)		Area in Square Inches	
	Rubber-covered Type R	Flamenol—Type SN	Rubber-covered Type R	Flamenol—Type SN
14 Sol.	.19	.130	.025	.0133
12 Sol.	.21	.147	.035	.0170
10 Sol.	.23	.168	.042	.0220
8 Sol.	.28	.227	.062	.0405
6 Strd.	.41	.314	.13	.0775
4 Strd.	.45	.363	.16	.1035
2 Strd.	.52	.423	.21	.1405
1 Strd.	.58	.496	.27	.1935
1/0 Strd.	.63	.537	.31	.226
2/0 Strd.	.67	.582	.35	.267
3/0 Strd.	.72	.634	.41	.316
4/0 Strd.	.78	.692	.48	.376

General Electric Company
Section WF-0138
Appliance and Merchandise Department
Bridgeport, Connecticut

Sirs: Please send me
- ☐ Information on Flamenol Building Wire
- ☐ Samples of Flamenol Building Wire

Name.....

Address.....

City..... *State*.....

GENERAL ELECTRIC

and a 7½-hp., 550-volt, three-phase induction motor were mounted above the machine on a special welded frame.

The framing in general is of ¼ x 3-in. strap-iron, with a maximum length at the top of 45 in., the motor being carried about 30 in. above the machine proper. The frame was bolted to the machine bearing housing and an idler provided to carry the 3½-in. drive belt between pulley sets. An across-the-line starter was mounted beside the motor and a single conduit riser from the floor fed the unit, with push-button control centrally above the machine and served by a single horizontal run of conduit from the starting box. The resulting arrangement compared favorably with other equipment in the shop from the standpoint of freedom from obstruction of work, safety and space economy.

•

Factory Feeder Goes Through Roof

To have gone underground with a 13.2-kv. cable to serve the increasing 60-cycle load in a recently acquired building of the Cutler-Hammer Company group in Milwaukee would have been unnecessarily costly. It would have made future changes difficult and, in addition, it might have entailed tearing up flooring under machine tools, interrupting production.

By bringing the service in overhead to a special dead-end structure on the roof, and thence through a unique, flat-roof bushing to an indoor substation on the first floor, a compromise was achieved by distribution engineers of the Wisconsin Electric Power Company which has proved simple, economical and effective in operation.

Principal members of the A-frame roof structure, which is 16 ft. high,

ROOF CABLE BUSHING solves plant service problem

8 ft. wide and 16 ft. 2 in. deep (in the direction of the line), are 3 x 3 x ¼-in. angles with side lacing of 2½ x 2½ x ¼-in. angles. Conductors (three No. 2) are brought in to disk strain insulators at the top of the A-frame, where lightning arresters are connected to a ground bus that leads into a ground pipe within the factory building.

From a three-pole pothead on the structure No. 4/0 lead-sheath three-conductor cable is led downward to a horizontal 5-in. channel attached to the structure and extending 3 ft. beyond it toward the roof coping. The cable is supported in this channel and from brackets on the coping until it reaches the roof bushing.

Details of the roof bushing are shown in the accompanying drawing. A 30-in. length of 3½-in. galvanized iron pipe extending about a foot above the roof level, and coupled to a 3½-in. fibre conduit at its lower end, was cast in a concrete duct. Through this duct the cable passes down through the building to the substation on the first floor.

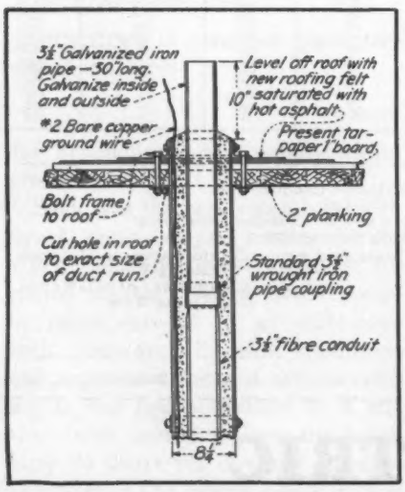
The cable is supported at the entrance to the duct by a cast brass support cap which fits over the 3½-in. iron pipe. The cable is sweated to this cap, which is designed to rest on the pipe, and in this way support the cable as well as provide some ventilation in the duct.

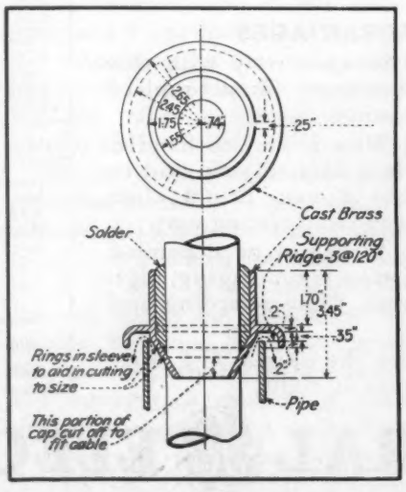
•

Electrolysis Stopped in Industrial Plant

The development of a leak in the fire service mains of the Revere Copper & Brass Company, New Bedford, Mass., led to voltmeter readings by a Factory Mutual engineer in view of suspected electrolysis. The tests showed that current from a street railway system was flowing through the earth to the fire service mains and through the Acushnet River to the transit power station. It was pointed out that pipe appearance alone is not proof of electrolysis, as corrosion from cinders, acid or salt has a similar effect.

Two solutions of the problem were considered: (1) Replacement of a length of the cast-iron pipe in the connection to the street main with a non-conducting pipe such as transite, and (2) making a metallic connection from the pipe to a good ground by bonding a copper cable to the pipe and terminating it at a copper casting in the river. The second alternative was chosen in view of its convenience and low cost. As an ampere of direct current is capable of removing as much as 20 lb. of metal in a year, it was recognized that the casting will in time be eaten away, but its replacement is readily effected.


3½"Galvanized iron pipe—30'long. Galvanize inside and outside
Level off roof with new roofing felt 10" saturated with hot asphalt
#2 Bare copper ground wire
Present tar-paper I'board
Bolt frame to roof
2"planking
Cut hole in roof to exact size of duct run
Standard 3½" wrought iron pipe coupling
3½"fibre conduit
8¼"



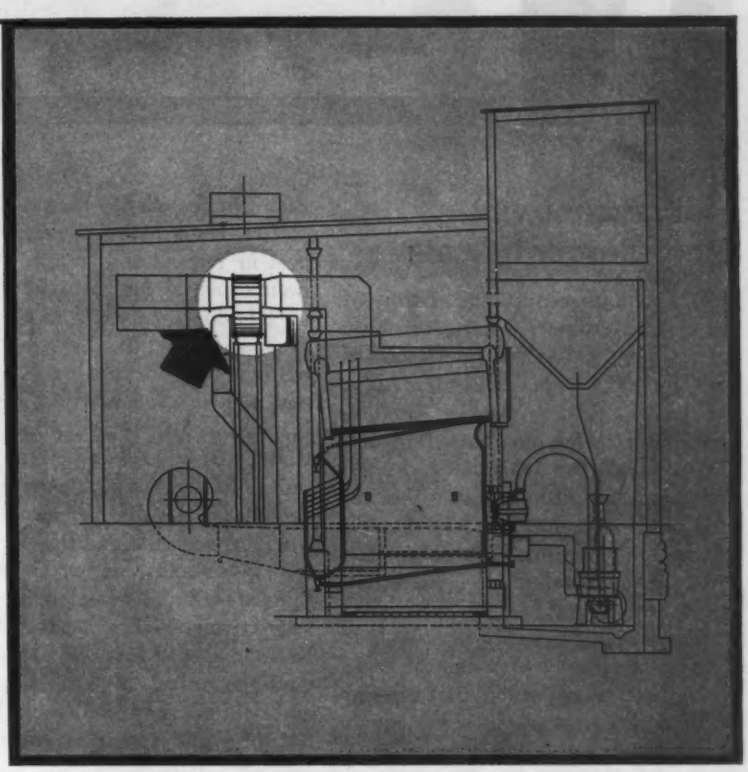
DETAILS OF ROOF BUSHING for 13.2-kv. service cable

41 Months = $20

In 41 months operation, repair costs for two Ljungstrom Air Preheaters at S. D. Warren Company have totalled but $20 each

At the plant of S. D. Warren Company, nationally-known paper manufacturers at Cumberland Mills, Me., two Ljungstrom Air Preheaters were included as a part of a modern steam generating unit completed early in 1937. Since that time, repair costs have totalled only $40, less than $.50 per month per preheater. What's more, no unscheduled interruptions to continuity of steam supply were required for servicing this equipment.

This performance record on an industrial steam source of moderate size is typical — not exceptional. At a load of 42,000 lb. steam per hr., gas enters the preheater at 550° F., preheating the combustion air to 430° F., contributing appreciably to the efficiency and stability of the unit as a low-cost source of power and process steam.



The Modern Ljungstrom Air Preheater

To the recognized thermal superiority of the *continuous regenerative counterflow* principle, the *modern* Ljungstrom Air Preheater now adds an extra measure of mechanical surety. The resulting clear margin of advantage for the Ljungstrom in any economic balance calling for high levels of heat recovery is indicated by today's installation records: Today more Ljungstroms are being installed in power plants than all other types of air preheaters combined.

Engineering evidence which confirms this margin of advantage — evidence which shows how constructional improvements have stepped up present-day performance—is available on request. It will be of noteworthy economic interest to engineers and other executives concerned with power-plant design or responsible for operating efficiency and availability. May we send a copy?

THE AIR PREHEATER CORPORATION

60 East 42nd Street **New York, N. Y.**

NEW ENGINEERING IDEAS

Fluorescent vs. Incandescent Costs

To facilitate rapid comparisons of the cost of ordinary incandescent vs. fluorescent lighting, M. A. Ulbrich of the Cambridge (Mass.) Electric Light Company has developed a "Sell-O-Graph" in which the only information required for analysis is (1) the rate per kilowatt-hour; (2) the annual burning hours, and (3) the difference in investment between the two types of installation. The device is $7\frac{5}{16}$ in. long x $2\frac{1}{4}$ in. wide, of celluloid construction, easily pocketed. It consists essentially of a central scale on both sides of which vari-colored slider scales running in slots constitute two adjustable bar graphs; that on the left showing incandescent and that on the right fluorescent costs.

The central scale represents the cost in (whole and tenths) cents per hour of supplying direct illumination of 20-odd ft.-candles in an average area of 200 sq.ft. Such an amount of light may be secured from either two 300-watt incandescent or six 48-in. white fluorescent tubes with a wattage of 300. For the above basic unit of illumination, energy costs are 0.6 × the rate per kilowatt-hour for incandescents and 0.3 × the rate for fluorescents, or, at 5 cents per kilowatt-hour, 3 cents and 1.5 cents respectively. This latter cost must be increased 15 to 20 per cent for daylight units. Actual lamp prices and data on lamp life should be used, but for broad average application the following data apply:

Incandescent—cost of 300-watt lamp, 750 hours life $0.50
Fluorescent—cost of 48-in. white tube, 2,500 hours 1.90
Lamp renewal costs per hour on 20 per cent standard package discount are 0.11 cent and 0.37 cent respectively.

In considering miscellaneous overhead costs (excluding amortization and obsolescence) 10 per cent on the investment (including lamps, fixtures and wiring) will approximate the annual charges for interest, taxes, insurance, maintenance, replacements, etc.

A typical comparison of incandescent and fluorescent costs follows:

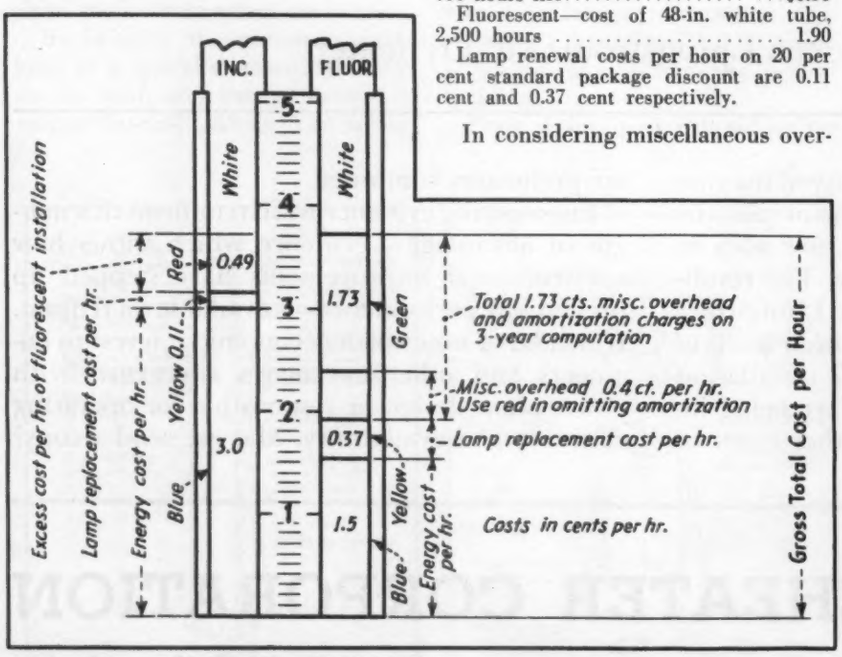
Taking as the objective 20 ft.-candles over 200 sq.ft., and using two 300-watt incandescents vs. six 48-in. fluorescents totalling 300 watts and an energy rate of 5 cents per kilowatt-hour, the energy costs per hour are 1.5 cents for fluorescent and 3 cents for tungsten service. Uncover the blue fields on the "Sell-O-Graph" to 1.5 and 3 cents, leaving the yellow sliders at these points on the central scale.

Lamp renewal costs figured as above are 0.37 cent per hour for fluorescents and 0.11 cent per hour for tungstens. Set the bottom edges of the red sliders at 0.37 and 0.11 cent respectively on the yellow slider scales. The central scale now shows a total cost to this point of 1.87 cents per hour for fluorescents and 3.11 cents per hour for tungstens.

The overhead costs are now figured. In the typical case the cost of six fluorescent units installed is $72 and of the tungstens $12. Ten per cent of the $60 difference is $6, or, with 1,500 annual burning hours assumed, 0.4 cent per hour. Set the green scale edge on the fluorescent side at 0.4 cent on the red slider scale. This brings the total cost of fluorescent service to 2.27 cents. The difference between the two illuminating costs, 0.83 cent (0.8 cent for convenience) is then immediately read off the green scale by setting the white slider's lower edge opposite the total cost (3.11 cents) of tungsten service indicated on the center scale of the device by the bottom of the left-hand red slider scale on the tungsten side.

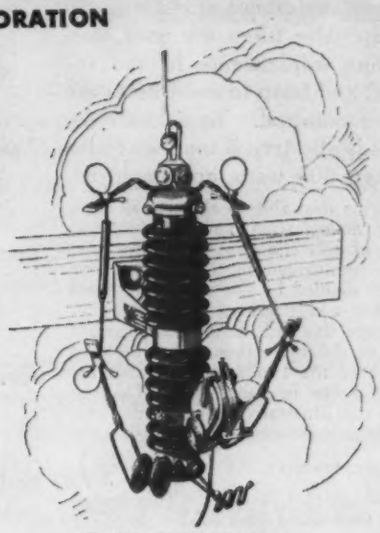
This difference of 0.8 cent per hour amounts to $12 per year with 1,500 hours of burning. Since the additional investment required in this case for the fluorescent installation was $60 for the unit area selected, it will take five years to pay back this difference by using fluorescents.

The final result is practically independent of the size of the light installation or of the lighting intensity since the same quantity of illumination from either source forms the basis of comparison. Where smaller



POCKET SLIDING SCALE HOLDER integrates energy, replacement, overhead costs for incandescent and fluorescent lamps. Scale settings for typical comparison of costs

FROM THE ENGINEERING DEPT.—JAMES R. KEARNEY CORPORATION



The Trip-O-Link Trip-Saver
5,000 to 15,000 Volt, 50 Amp.

Time Delay

ORDINARILY, for low cost protection of branch circuits or important distribution transformers, operating men select the popular, low-cost Kearney Trip-O-Link Trip-Saver, two-shot switch for 5,000 to 15,000 V., 50 amps.

But in some cases, operating men prefer a little longer delay between the time the protecting fuse blows and the second one throws-in to restore service . . . about 50 to 60 cycles delay would be ample, they decided.

So without disturbing the basic design or the fine operating characteristics of the widely used, inexpensive Kearney Trip-O-Link Trip-Saver that restores the second fuse more quickly, Kearney engineers developed a time delay device.

The time delay has been made to meet the field's requirements — replaces the second fuse link to restore service after an interval of 50 to 60 cycles. And may we direct attention to that popular Trip-O-Link feature:—as you quickly re-fuse this switch you really install a new cartridge each time (fuse cartridges are an integral part of the fuse links). Incidentally, from an engineering standpoint, study the switch, above . . . Its design is simplicity itself. No complicated parts to adjust — no conventional cartridges — a practical trip out mechanism . . . And, you'll be surprised at its inexpensive cost. Write for prices and details.

JAMES R. KEARNEY CORPORATION
4236 Clayton Ave., St. Louis, Mo.
Canadian Plant - Toronto, Canada.

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FOR BETTER MAINTENANCE and CONSTRUCTION

and correspondingly less efficient and more expensive tubes are used, corresponding adjustments in the energy cost and lamp renewal items are of course required. To a lesser degree this is also true if tungsten bulbs other than 300 watts are employed.

If it seems desirable to show total costs, including amortization and obsolescence, the item of miscellaneous overhead costs should be multiplied by 1 plus the quotient of 10 divided by the number of years allowed for amortization, and the result depicted on the red scale of the right graph. The difference then shown between the extent of the two graphs is then the actual difference in hourly cost of operation. In the illustrative case, if the customer selects three years for amortization, for example, multiply 0.4 by $\left(1+\frac{10}{3}\right)$, or 4.33, which is 1.73 cents. This brings the total fluorescent cost to 3.6 cents, or 0.49 cent per hour more than the equivalent lighting by incandescents. In this case the red slider on the fluorescent side shows the total fixed charges required.

Intangible factors such as quality of light and esthetics are not included in the comparisons by the device.

•

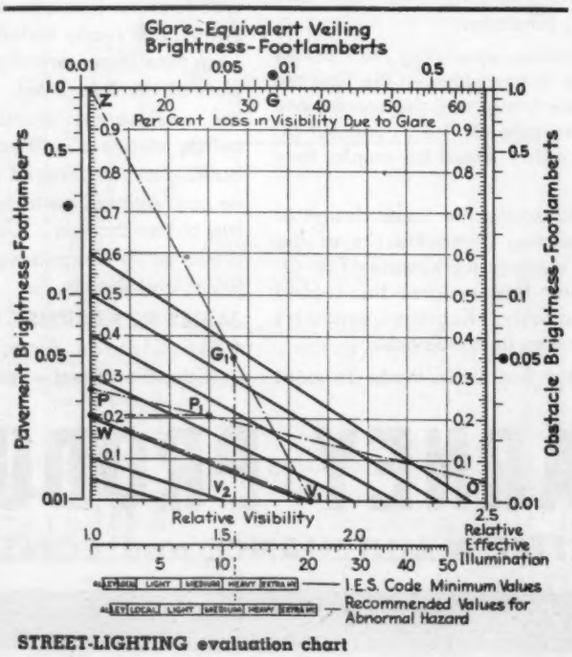
Evaluate Street Lighting with Chart

By KIRK M. REID and H. J. CHANON
Nela Park Engineering Department
General Electric Company, Cleveland, Ohio

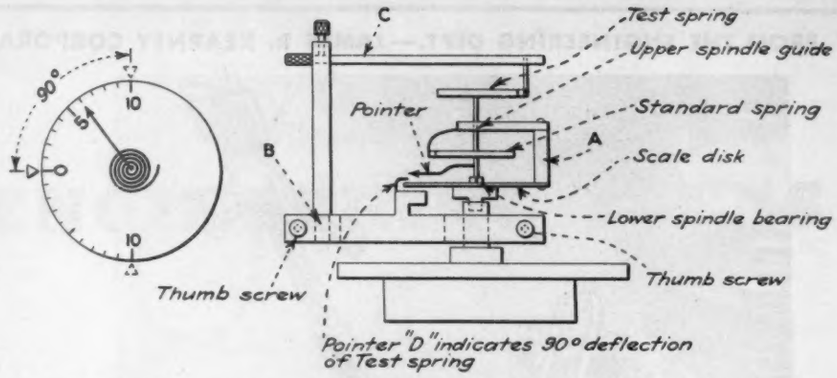
[ED. NOTE—In a previous article (ELECTRICAL WORLD, July 27, 1940, page 108) the authors described the recently developed street-lighting evaluator. In this article they tell how the evaluator card obtained with this device is used to determine quickly the value of net visibility of a street-lighting system.]

To illustrate a computation of visibility, brightness values in foot-lamberts of 0.27 for the pavement, 0.05 for the obstacle and 0.085 for glare are marked on the chart as large dots on the outside scales. Pavement and obstacle brightness values are transferred to the inside scales and are indicated by points *P* and *O*. The loss in visibility of 34 per cent due to glare is read directly on the upper scale at point *G*. On most thoroughfares it is considered that discernment is approximately 70 per cent by pavement brightness and 30 per cent by obstacle brightness. Such a weighting is obtained by joining *P* and *O* and marking the "weighting point" P_1, three vertical divisions from the left side of the chart and seven divisions from the right. A horizontal line WP_1 located the "weighted field brightness," at *W*. Line WV_1 is then drawn maintaining a proportionate displacement between the heavy diagonal guide lines. V_1 is the value of visibility, with glare disregarded.

To obtain net visibility the glare loss of 34 per cent must be applied. To do this graphically line V_1Z is drawn and point G_1 is located approximately midway between the third and fourth horizontal lines above the bottom of the chart. A vertical line through G_1 intersects the four scales at the bottom of the chart, one or more of which may be significant in any given evaluation of street lighting.



STREET-LIGHTING evaluation chart



DEVICE INDICATES spring torque directly in mm.-gr.

Measures Torque of Instrument Springs

A device for measuring the torque of instrument control springs directly in mm.-gr. is employed at the electrical laboratories of the Consumers Power Company, Jackson, Mich., for selecting the proper spring (strong or weak) to suit a given instrument condition. The device, developed in the laboratory, has a capacity up to 10 mm.-gr. to torque, positive or negative.

As shown in the accompanying sketch, the spring to be tested is mounted on a spindle in such a manner as to oppose the torque of a "standard" spring of known strength, from a G.E. H-5 wattmeter, that is attached to the same spindle. To make a test the system is brought to mechanical balance by either tightening or loosening the "standard" spring by moving the member "A" (solidly attached to both the scale disk and outer end of "standard" spring) until the pointer on the common spindle indicates zero on the calibrated scale. Then, with the spindle pointer initially at zero, the test spring is given a 90 deg. deflection, while the "standard" spring is held stationary. This is done by loosening the thumbscrews and moving the base member "B" (which carries the arm "C" attached to the test spring) through a 90 deg. arc with respect to the scale disk, which remains stationary. The pointer "D" on the base indicates when this 90 deg. deflection has been secured.

The difference in torque of the two springs is then indicated on the calibrated scale by the pointer attached to the common spindle as the "standard" spring is either tightened or loosened by action on test spring.

INTERNATIONAL DIESELS

Diesel Power reaches new peaks of efficiency in the *Four New TracTracTors by International Harvester*. Thanks to the ingenuity of Harvester engineers, a higher percentage of their maximum drawbar horsepower can be kept continuously applied to get more work done per day at the lowest possible cost!

In this complete series of DIESEL TracTracTors, you can now get International *design, quality, performance*—and International *full* DIESEL fuel economy—in sizes exactly suited to your power needs. Here's perfectly designed *balanced power* to team up with *balanced allied equipment*—to the profit of everyone.

Operator fatigue is engineered out . . . great working capacity, long life, and low maintenance are engineered in. All TracTracTor controls are within easy reach of the driver. Gear shifting is fast and easy. A wide range of traveling speeds provides close selection of speed to load and going. Multiple-disk steering clutches, mounted on ball bearings, are easy to operate. *Exclusive* track frame stabilizer and ball-and-socket pivot construction relieves the pivot shaft and track frames of leverage loads and assures positive track alignment.

Standardize on International Diesel TracTracTors and enjoy all the advantages only Harvester can provide. The nearby International industrial power dealer or Company branch will give you detailed information about this great line of crawlers.

INTERNATIONAL HARVESTER COMPANY
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180 North Michigan Avenue Chicago, Illinois

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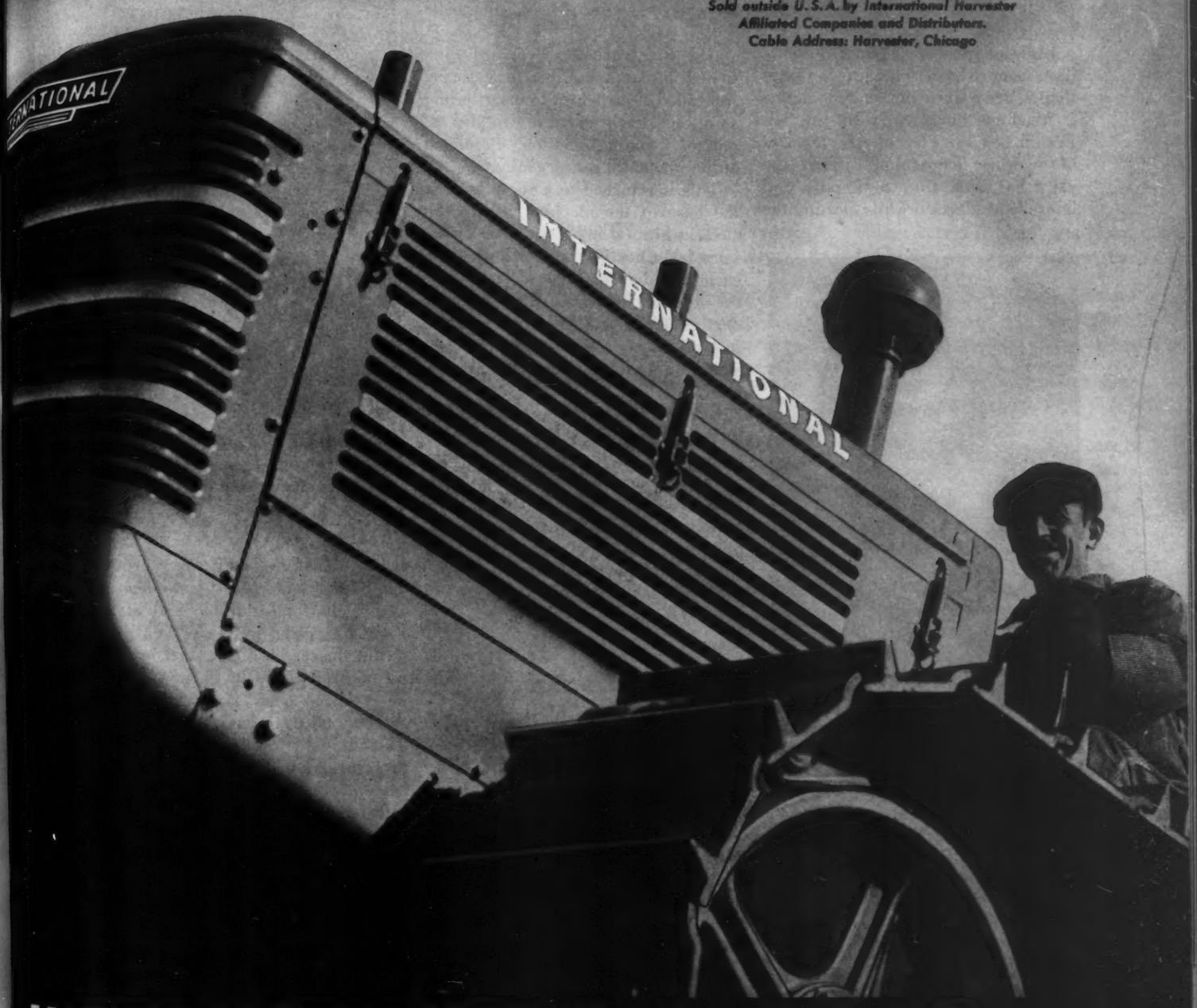


INTERNATIONAL Industrial Power

LOAD BUILDING

Temperature Control in Precision Grinding

By G. E. HERSAM
Pacific Gas & Electric Company, Oakland, Calif.

Finished piston inspection rejects have been reduced from fifteen to less than 1 per cent at the United Engine & Machine Company plant in San Leandro, Calif., by electric control of working temperature. Thus the plant has been able to simplify and improve production while meeting the rigid specifications of such customers as Hall Scott Motor Car Company and Pacific Greyhound Bus Company.

HEAT CONTROL applied at grinding fluid sump at base of machine. Thermostat is at left and two 2-kw. immersion heaters at right

Electric heating and temperature control has been applied at each grinding machine, where previous variations in atmospheric temperature made precision grinding difficult. A 30-deg. F. temperature change was found to cause an 0.0012-in. change in a 4-in. aluminum piston, whereas it was desired to hold tolerances within 0.00025 in.

The wide variation has been eliminated by applying thermostatically controlled electric heat to the grinding solution. Each machine contains 40 gal. of grinding solution, circulated at the rate of 20 gal. per minute.

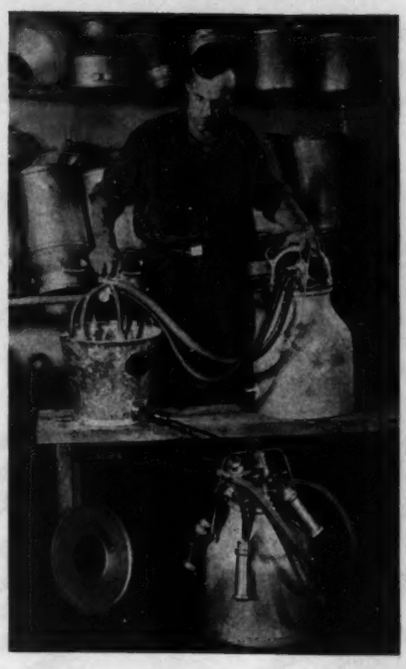
This is returned to a sump tank at the base of the machine, where the electric heat is applied. Two 2-kw. immersion heating units are used for each machine, and thermostats hold the solution temperature to within 2 deg. of 80 deg. F. The required heating was closely estimated, so that consumption approximates 4 kw.-hr. per hour.

Gages are held in the grinding solution to maintain them at the same temperature as the pistons. By this method piston tolerances have been held within the required limits. Operation proved so satisfactory on a pilot installation that all new grinding machines at the plant are being provided with this equipment.

•

Portable Heater Meets Farm Needs

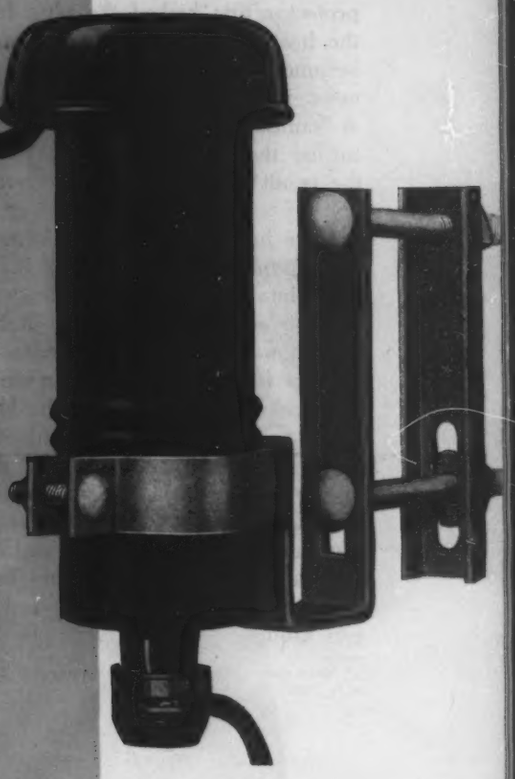
Like the invention of clothespins, paper clips and tire pumps, Carl Nickel's electric water pail idea clicked from the start because it filled a real need. Up in Alma, Mich., where he is rural service engineer for the Consumers Power Company, Nickel's farm friends had been "egging" him on for some time to find them a small electric water heater that they could carry around the farm; a low-cost water-heating device that was durable and at the same time safe.

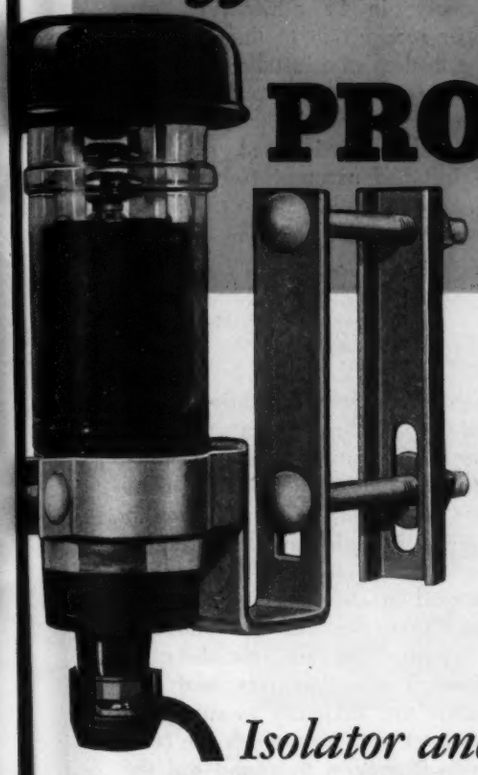


PORTABLE pail-type water heater (shown at left) for the farm brings hot water into stables and dairy. Plug kicks out if pail goes dry

But the search didn't start in earnest until one of the farmers got a nasty shock from a portable heater that he tried to make for himself. This started Nickel off on a series of experiments with pails and heaters. One of the first was with a heater soldered in a galvanized pail. It failed because the unit melted loose from the pail, but it showed him that a device had to be found that would protect the unit when and if the pail boiled dry. A number of things were tried before he hit upon an element with a built-in thermal

NOW L-M "Heavy-Duty" Lightning Arresters offer GREATER PROTECTION





Isolator and Glass body on all sizes are exclusive features on **L-M "HEAVY DUTY"** *Lightning Arresters*

HIGH SURGE CAPACITY due to a special valve material composition, chemically stable, which has proved to withstand far greater surges.

FAST ACTION because of electrically fast Ladder Gap which resists burning, pitting or overheating — also because of the low resistance of the valve material at high surges.

PROTECTION AGAINST RADIO INTERFERENCE is assured by the double seal against entrance of moisture. No breathing—no leakage.

THE ISOLATOR eliminates feeder lockouts due to follow-current through damaged arresters — it always disconnects the ground lead *instantly* and *only* when arrester is damaged.

TEST BY SIGHT—through the heat resisting Glass Body a visual inspection always tells the condition of the arrester.

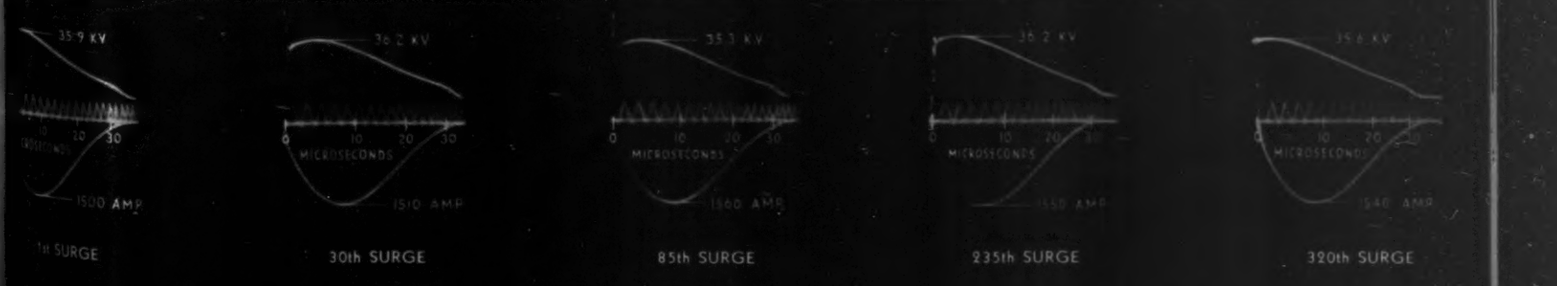
PERMANENCE OF CHARACTERISTICS because the valve material remains *unchanged* after hundreds of surges and years of service — it's always ready for action.

Further facts and figures are in the new Lightning Arrester Bulletin No. 40151. If you do not have your copy ask your L-M Representative or write to . . .

LINE MATERIAL CO., *Milwaukee, Wis.*

HAS PERMANENCE OF CHARACTERISTICS

VOLT-TIME AND AMPERE-TIME OSCILLOGRAMS ON 9000 VOLT ARRESTER



protector that kicked the plug from the heater socket when the element became overheated. This type element installed in heavy pails with a sanitizer cover for sterilizing turned the trick and Nickel turned the result* over to his farm customers.

Once in the hands of the farmers, they found a dozen uses for it. It went into the dairy farm to wash milking equipment, into the stables to heat water for animal care, to the chicken farm for scalding big chickens, and, on occasion, into the farm house to heat dish water and even bath water. But the thing that pleased the farmer, and in pleasing him sold him electric water heating, was the fact that the pail is portable and that at long last he could have hot water wherever he goes—and he gets around.

* Now commercially available—name of company supplied on request.

•

Year-Round Interest in "Light Conditioning"

By J. M. STEDMAN
Manager Residential Sales
Pennsylvania Power & Light Company, Allentown

Three fundamental factors must be considered in the promotion and sale of "light-conditioning" equipment: (1) Prove sales and profit possibilities of existing lighting market; (2) arouse dealer interest and support; (3) create customer acceptance. To develop properly each of these basic factors the Pennsylvania Power & Light Company sponsored a three-week test campaign in the spring of 1939. The results were entirely gratifying, as indicated by the fact that a total lamp load of 1,053,570 watts of "sight-saving" lamps were sold. With this initial activity, it became evident that continued promotion would be justified. Accordingly, a fall activity was planned, capitalizing on the national theme, "The Dawn of a New Day."

The company does not directly merchandise lighting equipment, other than Mazda bulbs. To create full dealer interest and support in "light conditioning," it was deemed advisable to use company salesrooms as display centers for the promotion of the cause and all interested customers were given a thorough eye conservation and "human-use" story on this essential home service, by trained floor personnel. These interested customers, in every case, were then referred to local dealers for purchase of the equipment.

Adequately to demonstrate and display this equipment a permanent light-conditioning service center was installed in each of the company's 63 salesrooms.

Visit Your Local
LIGHT CONDITIONING CENTER
BETTER LIGHT
BETTER SIGHT
..learn about Safe, Beautiful lighting
at Low Cost -
Here you will see Lighting at its best . . . Lighting that you can enjoy in your own home at Low Cost! You can do miracles with these new lighting fixtures for as little as $1.50 to $2.00 per room.
Visit the dealers displaying this Light Conditioning Center TODAY . . . and see the newest type lamps and lighting fixtures that will greatly improve the appearance and beauty of your home and, so important to all of you, make your lighting SAFE-FOR-SEEING.
MAKE Your LIFE BEGIN IN '40
LIVE AND WORK THE Electric Way
SEE THESE MODERN LIGHTING APPLIANCES ON DISPLAY AT THESE RETAILER LIGHT CONDITIONING CENTERS
S. S. Bashore Hardware.
Hillsburg Hardware Co.
Schaeffer's Electric Store.
D. G. Beaver.
G. G. Murphy & Co.
Sears, Roebuck & Co.
E. Simonetta.
Lee Myers.
W. H. Shaeffer.
E. Simonetta.
Snyder Electric Co.
J. E. Shenk & Son.
S. H. Goss & Son.
C. T. Rice & Son.
H. B. Solomon.
Harrisburg Hardware Co.
Robinson Dept. Store.
Stephen Hardware Co.
Hoover's Radio & Sup. Co.
Elwood D. L. Boss.
John B. Shupe.
Wm. W. Zeiders & Son, Inc.
PENNSYLVANIA POWER & LIGHT COMPANY

UTILITY ADVERTISING brings prospects to dealers

The result of this company effort is evidenced by total sales reported by all dealers to whom interested customers were referred, as follows:

14,966	I.E.S. lamps
16,909	Adapter units
12,240	Pin-to-Wall lamps
44,115	total unit sales

Distributors and manufacturers serving the territory became more enthusiastic in their desires for enlarged dealer outlets because of the success of this activity. The "Dawn of a New Day" was the opening wedge in a concentrated drive on a fertile lighting market by manufacturers, jobbers, dealers and the utility.

The initial objective in the company's year-round promotion of light conditioning was achieved, namely, that of securing customer acceptance of the service, and the whole-hearted support of dealers in stocking and selling adapter units, Silver Bowl lamps and Pin-to-Wall fixtures.

The 1940 spring activity, "Seeing Is Believing," was aimed at a new objective, that of arousing dealer interest in installing permanent light-conditioning service centers in their salesrooms, to demonstrate and display the service and equipment. The company, in its advertising, gave proper recognition to those co-operating dealers who installed these permanent centers.

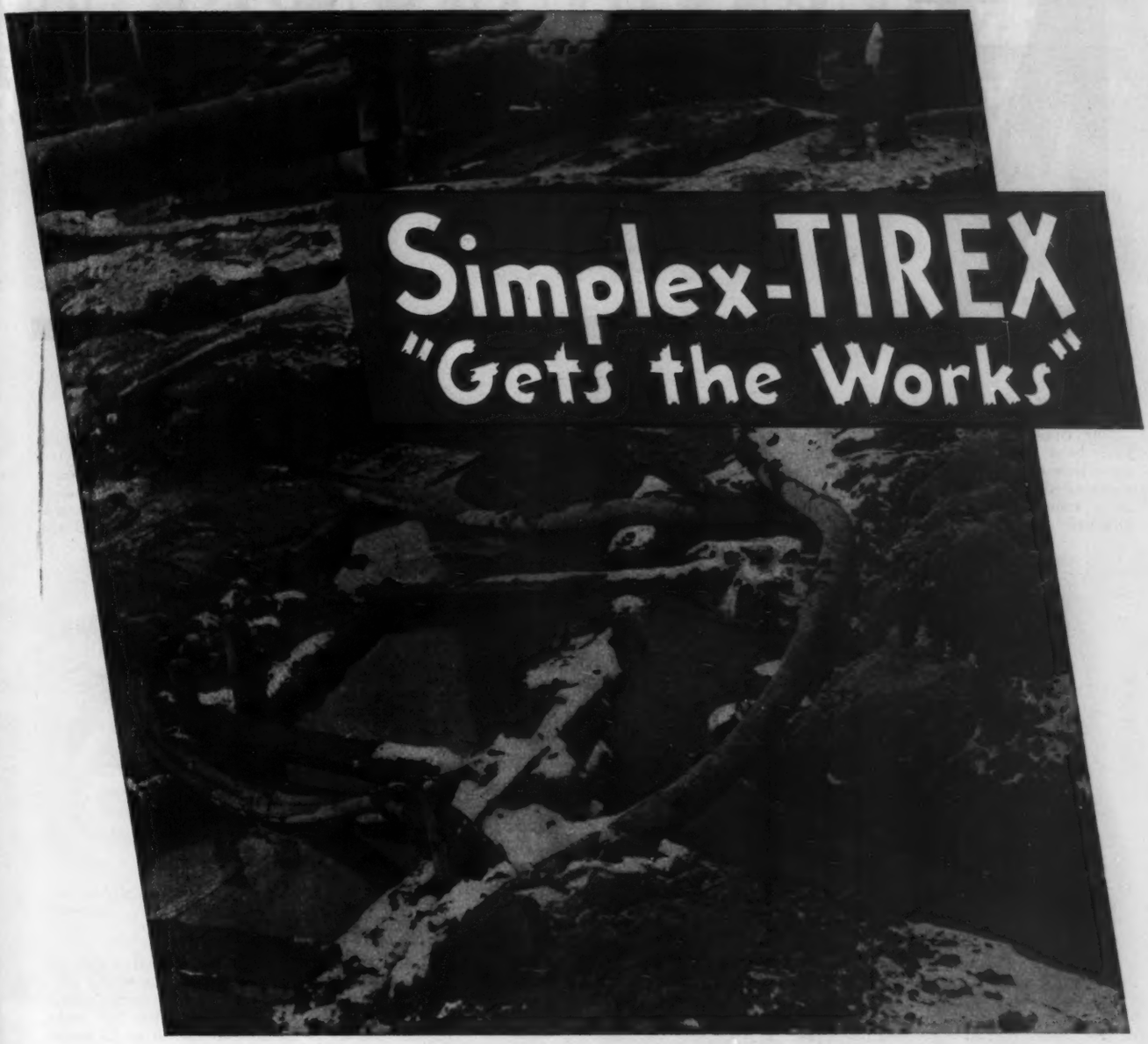
The results of this activity show 255 dealers participated, of whom 187 installed permanent centers and who reported additional sales as follows:

12,766	Modernizer units
11,109	Pin-to-Wall lamps
14,123	Silver Bowl lamps
104,791	Standard Mazda lamps
142,789	total unit sales

Sales of light-conditioning equipment have continued at a rapid pace since the activity concluded. Much of the dealers' interest is being maintained while activities are not in progress through the conducting of sales training schools for dealers' personnel in our ten company divisions. These schools are conducted by company lighting specialists.

Dealers, manufacturers and distributors are anxiously awaiting fall and winter activities which the company will suggest to round out the year's program.

With 187 permanent light-conditioning service centers already installed in dealers' salesrooms, with many others now making plans for the installation of centers before the fall lighting season, with the profits of the lighting market already proven to the dealers, with ample stocks of light-conditioning equipment available locally, and with the preliminary educational work already completed, we anticipate the fall activity will be the most inclusive of any yet conducted. We are now ready for a complete concentrated promotion by all associated agencies on the vast existing and continually growing lighting market.



Simplex-TIREX rubber sheathed portable cables "get the works" on a construction job like this. They carry on in spite of water, mud, run-overs, ice, etc., because of the protection offered by their selenium cured, tough rubber armor. This rubber armor is the toughest, most abrasion resistant, flexible cable covering available.

When you have a difficult problem for portable power cables — select the cable for the job. Don't use any old cable you have in stock. Get cable that fits the work.

We stand ready at all times to consult with you in an effort to supply you with the kind of a power cable you want.

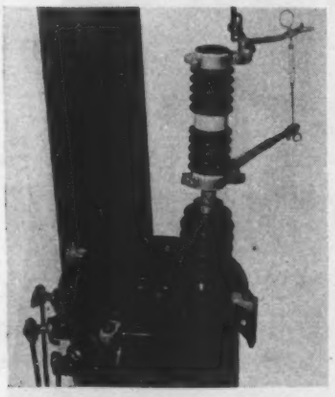
Simplex Wire & Cable Company, 79 Sidney Street, Cambridge, Mass.

Simplex-TIREX
The only cable armored with Selenium Rubber

NEW EQUIPMENT

Cutouts

The company states that improvements have been made in the designs of these open link cutouts, one type which can be mounted directly to the pole or attached to a crossarm and the other which is attached atop transformer bushings, thus



"Protectolink" cutouts for crossarm or pole type mounting and for mounting on top of transformer bushings (illustrated); ratings are 5 kv., 7½/12½ kv. "Y" grounded and 15 kv., all rated 50 amp. **W. N. Matthews Corp.**, St. Louis, Mo.

eliminating the connector terminal and hanger. The special "Protectolink" fuse link is inserted in the bottom arm and then pulled upward so that it can be seated in the upper rigid cast arm. When a fuse melts the arms are instantly pulled apart and short circuits or meltouts are cleared within ½ cycle and very high rupturing capacity results, it is claimed.

•

Fluorescent Unit

"Evenray" fluorescent units with models for two 20-watt tubes, two 40-watt tubes and four 40-watt tubes to be used on 118 volts, 60 cycles. **Infra-Red Ray Devices, Inc.**, 9325 East Forest Ave., Detroit, Mich.

The "Evenray" units are equipped with three eyebolt arrangement, allowing units to be hung in three different planes. Covers are fastened by wing nuts and attached by two chains, allowing cover to be hung at side of unit while servicing. One unit is 24 x 5 x 13 in., another 48 x 5 x 13 in. and a third 48 x 10 x 20 in. The units are finished throughout with "Duranite" and all surfaces are baked by the modern infra-red process.

Busbar Bender

Hydraulic busbar bender has been added to this company's line of hydraulic benders for rigid conduit, pipe and thin-wall steel tubing. **Greenlee Tool Co.**, Rockford, Ill.

The new hydraulic busbar bender is No. 770-BB, consisting of the standard power unit of the No. 770 and No. 770-T conduit benders, fitted with the busbar bending attachment. The complete tool or attachment is available. The bender will handle bars up to 4 in. wide and ¾ in. thick. The company claims that U-bends of any size may be made from the small "U" with a 3½ in. inside width.

•

Motors

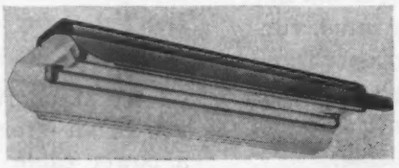
New and improved types AA and A3A motors to be used as general purpose power units. **Dumore Co.**, Racine, Wis.

Self-aligning bearings instead of the fixed type sleeve bearings replace the A and A3 motors of fractional-horsepower universal motors. The AA motor is equipped with larger brushes and an improved type of brush plug which is flush with the motor housing.

•

Fluorescent Luminaire

Luminaire is arranged for rigid or flexible conduit, or chain suspension mounting; Levolier switches may be installed if



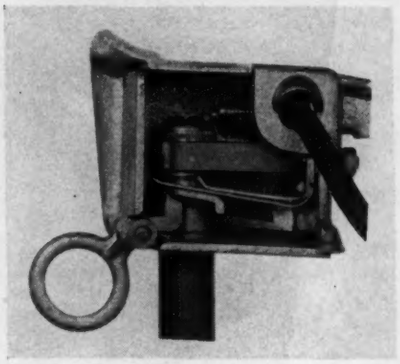
New open-end twin-lamp fluorescent luminaire type FPR, utilizing 40-watt, 48-in. Mazda type F white or daylight fluorescent lamps, available only in the spread distribution style for operation on 110-125, 199-216 and 220-250 volts, 60 cycles, a.c. **Westinghouse Electric & Mfg. Co.**, East Pittsburgh, Pa.

desired. This new product was designed especially for general or supplementary lighting of low bay industrial areas.

WHO MAKES WHAT?—If it's electrical, look first in "Electrical World" *Electrical Buyers Reference.*

Open Fuse Cutout

A feature of the new unit is a totally inclosed contact construction for protection against snow and dirt, corrosion caused by weathering, and the formation of ice on the contacts. The toggle mechanism and lower contact are also inclosed.



Open fuse cutout for use on distribution circuits of 15,000 volts and below. **General Electric Co.**, Schenectady, N. Y.

In operation of the new cutout, contact is made by heavy spring contacts which press down against the horizontal contact on the fuseholder cap. When the fuse link melts, contact is maintained for 10 to 15 cycles, after the fuseholder has dropped, to provide time delay for clearing the short-circuit current arc within the tube, so there will be no interruption.

•

"Packaged" Outlets

Six different combinations of "Plug-In" strip, together with the necessary fittings for installation of additional outlets. **National Electric Products Corp.**, Pittsburgh, Pa.

The six packages range from four outlets along 6 ft. 6 in. of wall space, upward to twelve outlets along 24 ft. 6 in. of wall space. The package contains "plug-in" strip, fill-in strip, 15 ft. of A.B.C. cable to run or aid in the installation of separate circuit where needed and connector for connection of cable.

•

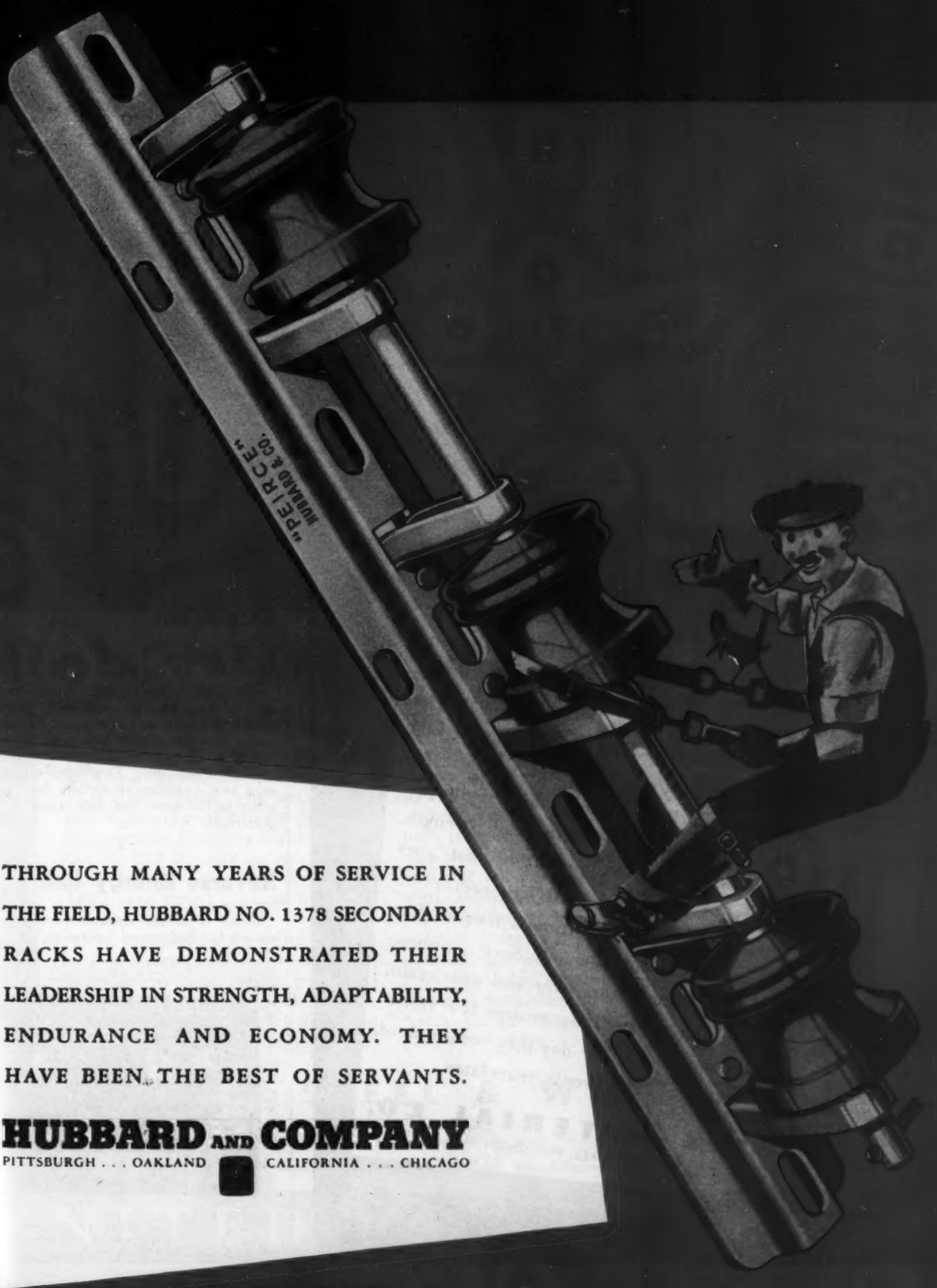
Hose Trailer

Fire-fighting trailer, two and four-wheel units. **C-O-Two Fire Equipment Co.**, Newark, N. J.

To fill the need for a larger capacity, carbon dioxide type, fire-extinguishing

"TO BE A GOOD LEADER-

ONE MUST FIRST HAVE BEEN A GOOD SERVANT"



THROUGH MANY YEARS OF SERVICE IN THE FIELD, HUBBARD NO. 1378 SECONDARY RACKS HAVE DEMONSTRATED THEIR LEADERSHIP IN STRENGTH, ADAPTABILITY, ENDURANCE AND ECONOMY. THEY HAVE BEEN THE BEST OF SERVANTS.

HUBBARD AND COMPANY

PITTSBURGH . . . OAKLAND CALIFORNIA . . . CHICAGO

"HANG THE LOAD ON HUBBARD HARDWARE"

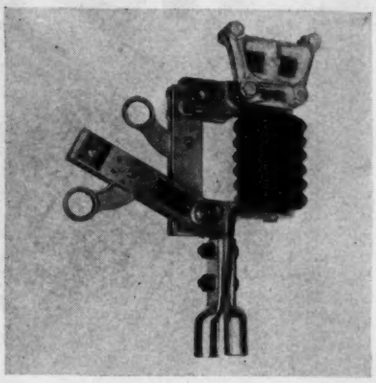
MACHINING
like this
Makes CONTACTS
like this
L-M Split Bolt Connector
L-M Nut Retainer Connector
L-M Drop-On Connector
Twirl the nut on *any* L-M Connector and note how smoothly it glides up the thread. Right there you have the evidence of *perfect machining*, and the big reason why L-M Connectors give you such high pressure between conductors at remarkably low torque. Machining like this, plus the high strength, corrosion-resisting, copper alloy that goes into them, enables L-M Connectors to withstand far higher ultimate torque than service conditions demand. *Save* . . . re-use your L-M Connectors over and over again. Their high conductivity assures low resistance connections, the day they come out of the carton . . . and twenty years later.
LINE MATERIAL CO.
MILWAUKEE, WISCONSIN

unit, this trailer can be attached to truck or tractor. Carries as many as ten 50-lb. cylinders of carbon dioxide gas or less, with one or two hose reels with 100, 150 or 200 ft. of high-pressure hose and discharge horns. For protection of widely separated flammable liquid or electrical hazards.

•

Disconnecting Switch

Clamping directly on the busbar, this new switch offers a very convenient oil breaker disconnect for open type switch-



Bus type disconnecting switch with ratings from 7,500 and 15,000 volts, 400, 600, 800 and 1,200 amp.; the 400- and 600-amp. switches have single blades. **Delta-Star Electric Co.**, Chicago, Ill.

boards. It is of the latest design with tongue type full floating blades, line-pressure contacts, annular ring line-pressure hinge and bolt type lock between contact and hinge to preserve headroom.

•

Outlet Box

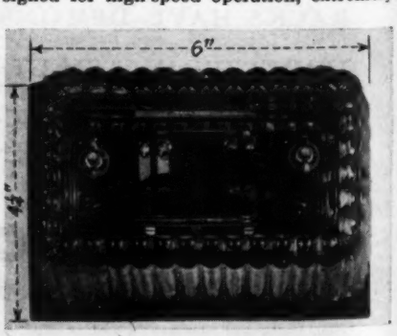
Double-end outlet box for thin wall partitions. **General Electric Co.**, Bridgeport, Conn.

To simplify the installation of switches and outlets in the thin wall partitions found in hotels and apartment houses, this outlet box has a new box made of a shallow cover and a redesigned extension ring to double-end use. The combination permits two switches or outlets beside each other in the same box, but facing opposite directions.

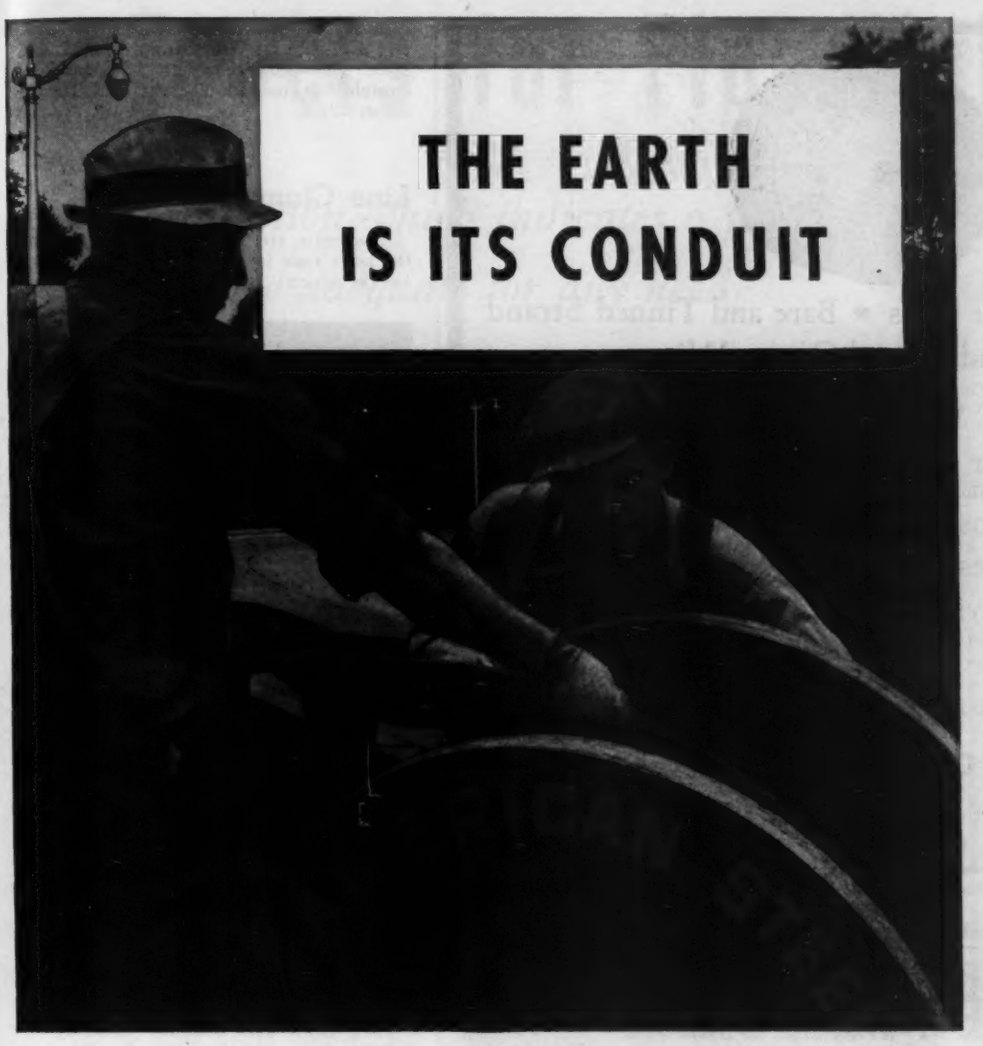
•

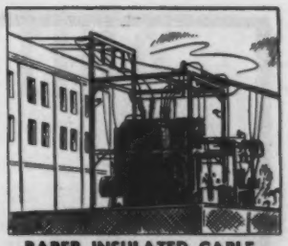
Reverse Energy Relay

Relay is of the dynamometer type, designed for high-speed operation, extremely



A new relay (type QNR) designed for both single and polyphase service. **Palmer Electric & Mfg. Co.**, Wakefield, Mass.




PAPER INSULATED CABLE

AMERBESTOS CABLES

VARNISHED CAMBRIC CABLES

RELIANCE WEATHERPROOF WIRES

AMERCLAD CABLES

BUILDING WIRES

AMERSEAL PARKWAY CABLE

gives lasting service buried directly in earth

NO ducts. No conduit. No external protection of any kind. That's the reason why contractors and engineers prefer to use Amerseal non-metallic Parkway Cables. They can be laid directly in an ordinary plowed furrow or hand-cut trench. They save time . . . save materials . . . save money.

The conductors are tightly sealed in a moisture-proof jacket of tough, lively rubber, and further protected by a covering of asphalted jute. Neither moisture nor earth acids and alkalis can penetrate. In hundreds of installations, Amerseal has proved its ability to give years of trouble-free service at rock-bottom cost.

Amerseal is versatile. You can bury it directly in the ground, run it up a pole, attach it to a structure, or string it on a messenger. In every application you'll find it effective.

For circuits which require more positive protection against physical damage, use our metallic types of Parkway Cable, sheathed in lead and armored with steel or bronze. Send today for our complete catalog of Parkway Cables.

AMERICAN STEEL & WIRE COMPANY

Cleveland, Chicago and *New York*

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* — United States Steel Export Company, New York

UNITED STATES STEEL

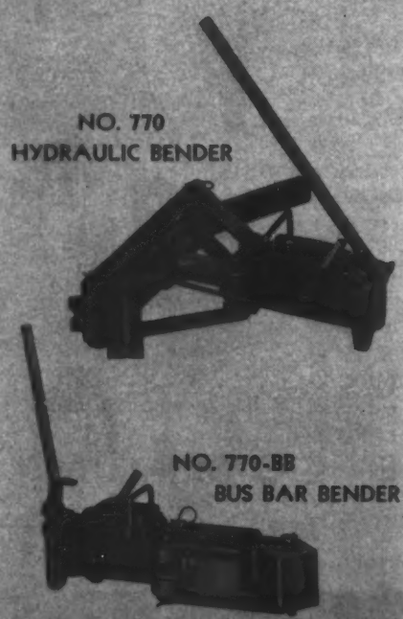
Hot Rolled Copper Rods • Bare and Tinned Strand
Bare and Tinned Copper Wire
(In Rounds, Flats and Squares)
URC Weatherproof Wire
Cotton, Paper and Asbestos Magnet Wire
(In Rounds, Flats and Squares)
Rubber Insulated Wires and Cords
Lead Covered Cables • Multiconductor Power Cables
Network, Service Entrance, Control Cables

ROME-60

That New, Tough, 60% Jacketed, Heavy Duty Portable Cable

ROME CABLE
CORPORATION
ROME, N.Y.
SALES OFFICES:
New York Chicago Cleveland Pittsburgh Detroit
Boston Richmond Philadelphia Los Angeles

GREENLEE Hydraulic Benders
Can Save You 15 to 75% On Bending Costs



The powerful Hydraulic Units on Greenlee Benders make the job of bending conduit and pipe so easy that one man can quickly develop the pressure needed to bend any conduit from 1¼ to 4½ inches. You can save enough on labor costs alone to more than pay for the bender. Many users have said that Greenlee Benders have lowered labor and material costs anywhere from 15 to 75%. The No. 770 Bender with a maximum pressure of 25 tons will handle conduit from 1¼ to 3 inches while the large No. 775 with a maximum pressure of 40 tons can bend 3 to 4½-inch conduit. The new Hydraulic Bus-Bar Bender will bend bus bars up to 4" wide and ¾" thick, and make U-bends with a minimum inside width of 3½ inches. Write for more detailed information about the complete line of Greenlee Benders and attachments.

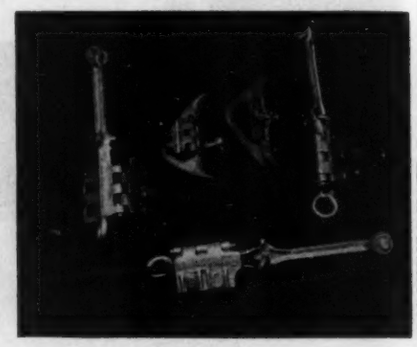
GREENLEE TOOL CO., 1705 Columbia Ave., ROCKFORD, ILL.

compact (4¼ x 6 in. in No. 1 QNR size), and available for either front or back and front and back contacts. Substantially straight-line operation curve and rugged construction.

•

Line Clamps

The units are hinged on one side and the bolts (one for the suspension type, two for the strain) are on the other side, well



A series of line clamps; illustrated are the No. 4/0 long strain and suspension which will accommodate wire sizes from No. 2/0 to 250,000 circ.mil. **Clair E. Compton,** 2419 Fernleaf St., Los Angeles, Calif.

apart to allow access with a wrench and permit easy manipulation with hot sticks. Absence of loose parts is said to be a safety feature.

•

Boring Machine

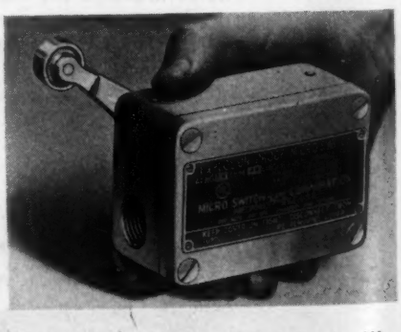
Hubron earth-boring machine powered by a four-cylinder, 40-hp., water-cooled engine mounted on an automobile chassis. **The Buda Co.,** Harvey, Ill.

These drills were designed primarily for military purposes, but may also be used for drilling holes for pole line work. The company claims that the machines will drill holes from 12 to 42 in. in diameter and up to 24 ft. in depth. They are a development of a smaller type used by telephone and power company for digging holes for poles.

•

Explosion-Proof Switch

The new feature of these switches is the housing, 3⅝ x 2½ x 2 in., which is said to be explosion-proof. The switches are especially adaptable for atmospheres containing vapors of ethyl ether, gasoline, alcohol, acetone, lacquer solvents, etc.,



Explosion-proof switch, 1,200 watts to 600 volts a.c.; single-pole, double-throw contact arrangements. **Micro Switch Corp.,** Freeport, Ill.

Towers for Floodlighting

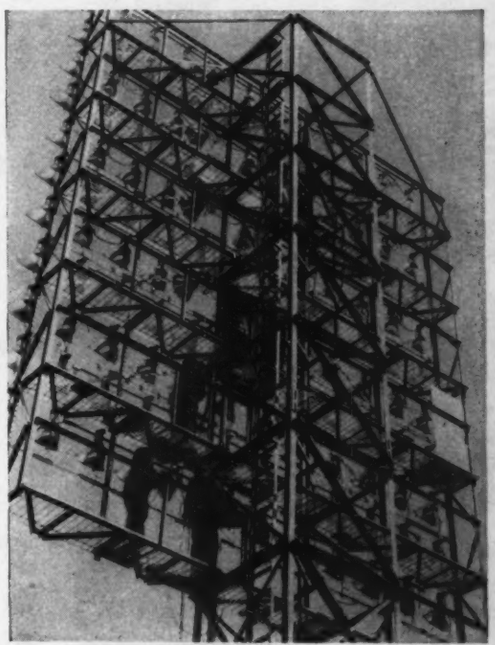
An installation which indicates a tower service adequate for any need

VERSATILITY in the design and erection of towers for floodlighting purposes, from the most simple of standard types to those which call for special consideration and unusual design, has always been a characteristic of American Bridge Company's tower service.

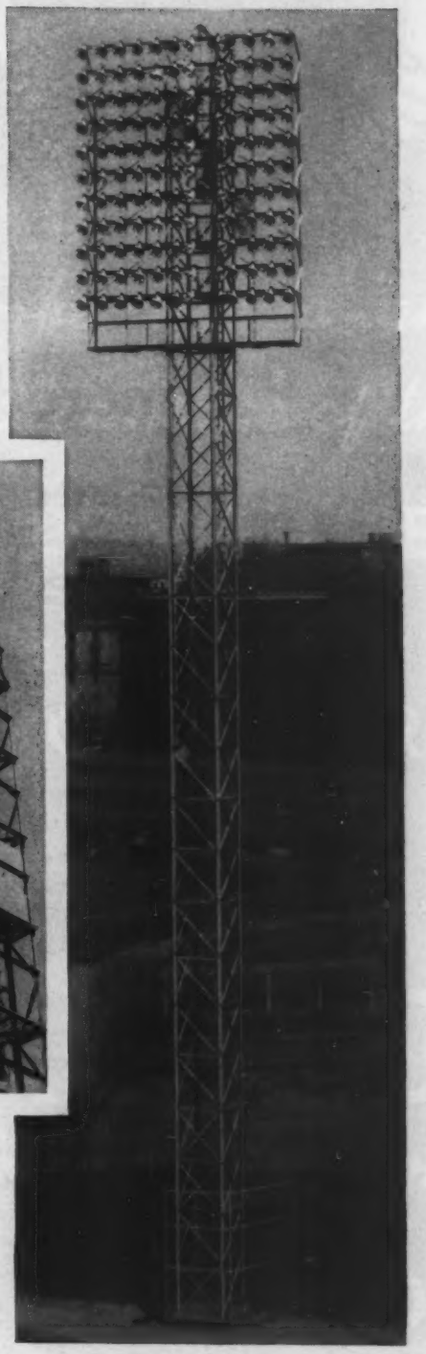
An outstanding installation is that recently made for the Pittsburgh Athletic Company, Forbes Field, Pittsburgh, where the towers are the backbone of a floodlighting system greater in magnitude than any heretofore developed for a baseball park. Clustered some 150 feet above the playing field of the Pittsburgh Pirates, 864 floodlights supported on eight American Bridge-built steel towers turn night into day.

Three of these galvanized towers, located in the outfield, rise the full 150 feet above their concrete foundations. The remaining five are supported by the existing structural steel roof frame of the grandstand, the trusses and columns of which were field-altered and reinforced to withstand the added strain. All eight were designed, fabricated and installed complete, even to the concrete foundations, by American Bridge Company.

However, many installations have much simpler requirements than those described above. For these our service is comparable in every respect. In addition, our Tower Department has developed a series of standard floodlight poles which are promptly available and unusually economical as to materials and installation. Why not refer your requirements to our nearest contracting office?



↑**CLOSE-UP VIEW** of a floodlight cluster. Eleven arms, each 26 feet long, cantilever on either side of the tower shaft to support 132 lights. Each level is framed with a maintenance platform and safety railings. An access ladder extends the full height of each tower.



ONE OF THE 150-FT. outfield floodlight towers carrying a cluster of 132 lights. Lights and electrical equipment were engineered by the Westinghouse Electric & Manufacturing Co. Tower base is protected by galvanized wire fencing manufactured and erected by Cyclone Fence Company, another subsidiary of the United States Steel Corporation. →

AMERICAN BRIDGE COMPANY

General Offices: Frick Building, Pittsburgh, Pa.

Baltimore · Boston · Chicago · Cincinnati · Cleveland · Denver · Detroit
Duluth · Minneapolis · New York · Philadelphia · St. Louis

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Export Company, New York

UNITED STATES STEEL

RUBBER COVERED POWER CABLES • BUILDING WIRE

CRESCENT

GENUINE

A.B.C.

Armored Bushed Cable

1. CONDUCTOR — flame retarding, printed showing size, type of insulation and voltage.

2. BUSHING—easy to insert as paper unwraps from under both ends of armor to make room for the bushing.

3. STEEL ARMOR—low resistance, electro-galvanized giving longest life.

4. Thoroughly tested at several points during manufacture and receiving a final test of 2000 volts between conductors and armor.

5. *CRESCENT has unexcelled facilities for the complete manufacture of Armored Bushed Cable in all its steps. When you buy CRESCENT A.B.C. ARMORED BUSHED CABLE you buy the best. Do not be satisfied with any substitute.*

CRESCENT
INSULATED WIRE & CABLE CO. INC.
TRENTON, NEW JERSEY

Atlanta Baltimore Boston Buffalo Chicago Cincinnati Cleveland
Detroit Indianapolis Kansas City Los Angeles Minneapolis
New Orleans New York Philadelphia Pittsburgh St. Louis San Francisco

CRESCENT ENDURITE SUPER - AGING INSULATION

CRESFLEX NON-METALLIC SHEATHED CABLE • SERVICE ENTRANCE CABLE • MAGNET WIRE • BARE WIRE

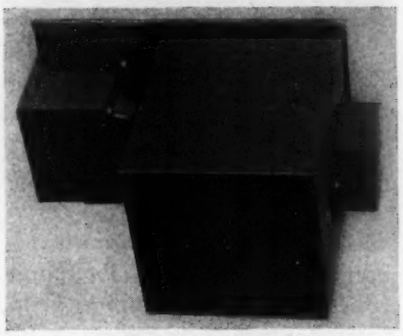
VARNISHED CAMBRIC • FLEXIBLE CORDS • LEAD ENCASED AND PARKWAY CABLES • ARMORED CABLE

and for grain dusts. The types of actuation available are the roller arm, with the axis of the roller either parallel to or at right angles to the arm, and a bullet nose push rod type.

•

Black Lights

As the beam patterns of black light equipments designed particularly for spot or flood lighting are essentially circular, these new lights have been developed to throw a narrow beam confined to the aisle carpet with no spill over adjacent areas. Model 67 is designed for flush mounting in suspended ceilings, the lamp unit fitting down into and held by an upward extension of a plaster ring. Model 68 is for attached mounting to ceilings, with lamp holding brackets which allow adjustment of the lamps in all directions. The black light filter in each unit comprises a plate of special heat-resisting dark-colored ultra-violet transmitting glass. The mercury lamp utilized is 100 watt.



"Conti-Glo" black lights; Models 67 and 68 illustrated) for fluorescent aisle carpet lighting. **Continental Lithograph Corp.**, Cleveland, Ohio.

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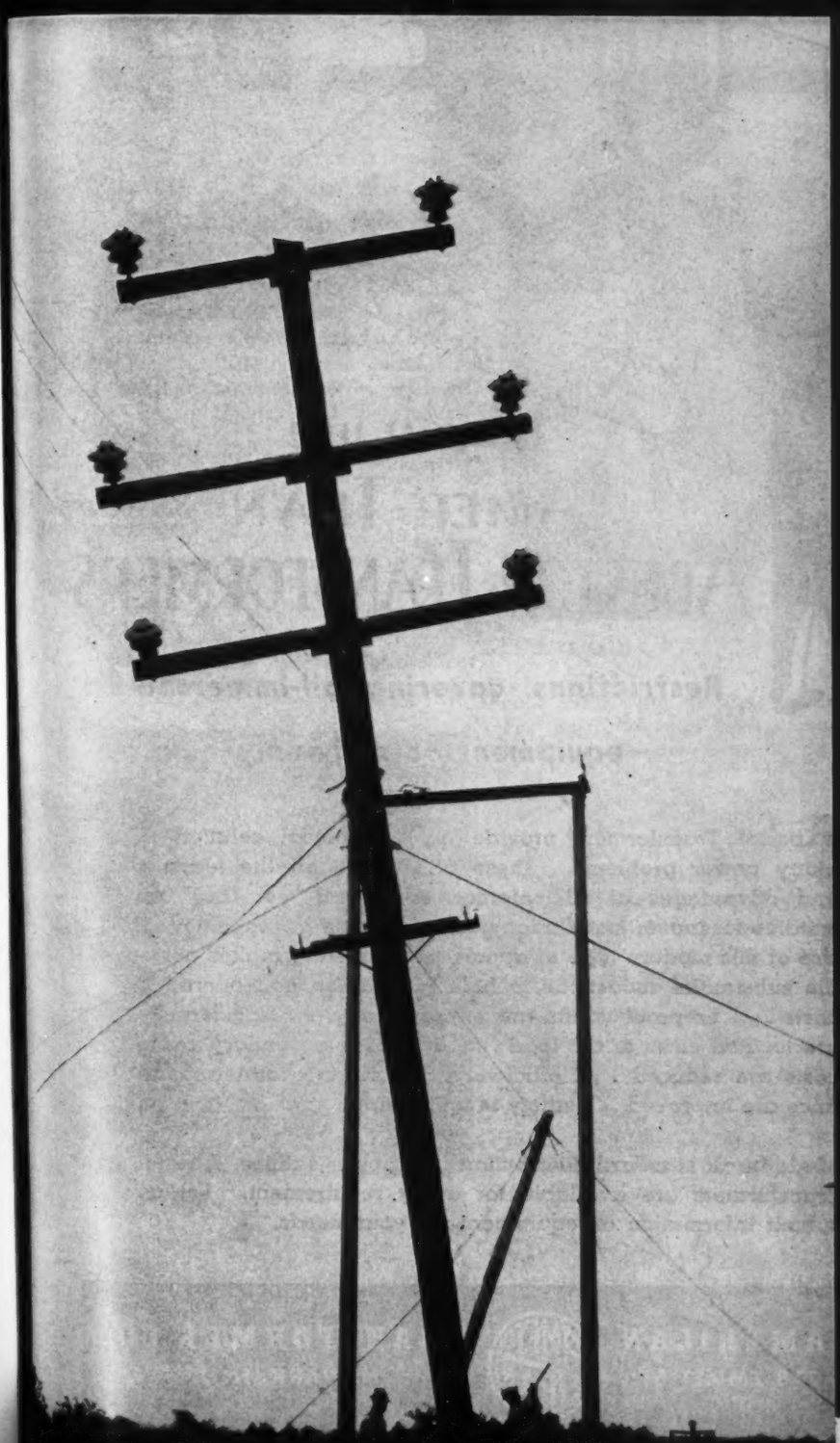
TECHNICAL LITERATURE

LUMARITH PROTECTOID—Its characteristics and applications for the electric industry prepared for engineers by the Celluloid Corporation, 180 Madison Ave., New York, N. Y. This data and specification book should be useful to those who are interested in electrical insulation. It also contains information on Lumarith Protectoid as to its characteristics, applications and advantages in electrical industry.

STEEL CROSSARM BRACES—These "Suggestions for Specifications" were prepared by the Line Hardware Subcommittee and approved by the Transmission and Distribution Committee, Edison Electric Institute, 420 Lexington Ave., New York, N. Y. They should be useful to companies in preparing their own standard specifications for the purchase of these materials. Types of materials, tests and general information are included.

HANDBOOK—New handbook and data bulletin on fluorescent lighting, containing 46 pages of charts, diagrams, tables and photographs. Bulletin 40 contains a section, in question-and-answer form, giving data on fluorescent lamps and their operation. Remaining pages contain information on the company's fluorescent lighting equipment. Copies are obtainable from Sales Promotion Department, Benjamin Electric Mfg. Co., Des Plaines, Ill.

MODERNIZING YOUR LINES?



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LONG-LIFE

and

TROUBLE-FREE SERVICE

found in

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POLES

Send for the new AmCreCo Handbook on Creosoted Poles. It's valuable and free

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GEORGIA CREOSOTING COMPANY INCORPORATED

ADDRESS INQUIRIES TO CHICAGO, ILL., OR LOUISVILLE, KY.

You can install it *near the load*

If you use AMER-TRAN ABESTOL* TRANSFORMERS

Restrictions covering oil-immersed equipment do not apply

Fire-proof

Installation Costs Reduced

Abestol-Liquid, listed by Underwriters' Laboratories

Greater Convenience

Improved Appearance

No Fireproof Vault Required

Abestol Transformers provide an economical solution to many power problems. These units have all the features and advantages of oil-immersed equipment, yet they are suitable for indoor installation with many restrictions removed. Use of this modern type of apparatus frequently makes possible substantial reductions in both installation and operating costs . . . fireproof vaults are unnecessary . . . transformers are located close to the load . . . expensive secondary cable costs are reduced . . . efficiency, performance and appearance are improved . . . safety is unimpaired.

- **Made in all standard distribution and power ratings, Abestol Transformers are available for every requirement. Let us submit information on equipment for your needs.**

★ ABESTOL is a non-inflammable, non-explosive insulating fluid used in place of transformer oil in especially designed equipment. Use of Abestol is licensed under the Pyranol Patents of the General Electric Company.

AMER TRAN

Manufactured Since 1901 at Newark, N. J.

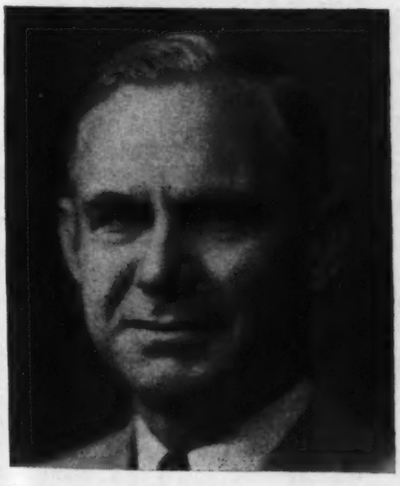
AMERICAN TRANSFORMER CO.
178 EMMET ST.
NEWARK, N. J.

NEWS ABOUT PEOPLE

Pearce and Grinnell Get Assignments in Far East

The appointments of Homer U. Pearce and Carroll C. Grinnell as vice-president and manager, respectively, of the International General Electric Co. in the Far East, have been announced. Mr. Grinnell has also been elected president and general manager of the General Electric Co. (P.I.) Inc. at Manila. Both men will make their headquarters at Tokyo, Japan.

A native of Ishpeming, Mich., and a graduate of the University of Michigan, Mr. Pearce became associated with the Edison Lamp Works, and in 1919 he was made factory superintendent of the Newark plant. He went to Japan in 1924 as engineer with the Tokyo Electric Co. and five years later was made



H. U. Pearce

managing director and vice-president of that company.

Mr. Grinnell entered the test course of the General Electric Co. following graduation from Union College, Schenectady, in 1919. Later he worked as an office engineer in the International General Electric Co. at Schenectady

C. C. Grinnell

until 1922, when he was sent to the Far East. He has been located at Manila for the past five years.

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▶ DR. JOHN H. LAMPE, professor of electrical engineering at the University of Connecticut, has been named dean of engineering, succeeding Dr. Walter L. Edel, who has resigned to enter private industry.

▶ W. C. MORGENSTERN has been named assistant chief engineer at Copperweld Steel Co.'s new steel plant at Warren, Ohio. He was previously connected with American Steel & Wire Co., Carbon Steel Co., Blaw-Knox Corp., Barium Stainless Steel Corp., and as special consulting engineer with Thomas Hilliard.

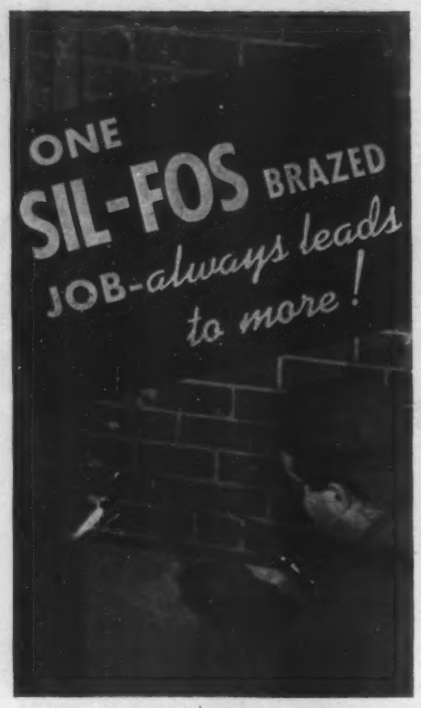
▶ D. L. MARLETT of Portland, Ore., has been named assistant to Bonneville Power Administrator Paul J. Raver, succeeding U. J. GENDRON, recently appointed assistant Bonneville power administrator. Mr. Marlett joined the Bonneville staff in September, 1939, when he became Dr. Raver's technical assistant.

Northwest Electric Group Elects C. J. Strike Head

C. J. Strike, president of the Idaho Power Co., was elected president of the Northwest Electric Light and Power Association for the year 1940-41 at the association's annual meeting in Seattle last month. He succeeds J. E. E. Royer, vice-president and general manager of the Washington Water Power Co., who has held the position during the past year.

S. P. MacFadden, vice-president Puget Sound Power & Light Co., was elected to the vice-presidency, while the following were named vice-presidents for their respective states: Idaho, John D. Orr, Idaho Power Co.; Montana, Robert O. Kerr, Montana Power Co.; Oregon, James H. Polhemus, Portland General Electric Co.; Utah, W. A. Huckins, Utah Power & Light Co.; Washington, C. Patrick Johnson, Puget Sound Power & Light Co.; British Columbia, E. H. Adams, B.C. Electric Railway Co.

Members-at-large of the executive committee elected at this meeting were Z. E. Merrill, Mountain States Power Co., Albany, Ore.; R. M. Loughrey,



THIS picture, taken in a substation of a large utility company, shows an 11-kv section of a ground bus being brazed with Sil-Fos. Sil-Fos brazing was used because "results on an earlier application of this method were so satisfactory".

Once Sil-Fos brazing of bus bars is tried its advantages are so plainly evident that further use invariably follows. Besides doing away with drilling or punching time, bolts, clamps and assembling labor, Sil-Fos brazing requires smaller laps, saving substantial amounts of copper. It provides joints that are high in electrical conductivity—that are strong and won't loosen up and can't oxidize internally. In effect, Sil-Fos brazed bus bars are jointless, joint maintenance is eliminated.

Try this sound, more economical method of joining bus. Specify Sil-Fos brazing on your next bus bar job! As a preliminary, write today for Bulletin EW-58.

HANDY AND HARMAN
82 Fulton St.
New York, N. Y.
Agents in Principal Cities
HANDY & HARMAN of Canada, Ltd., Toronto

General Electric Co., Portland, and V. G. McCain, Graybar Electric Co., Spokane.

•

New Officers Appointed by Pittsburgh Reflector

John A. Hoeveler, manager of the engineering department of the Pittsburgh Reflector Co. since 1926, has been named first vice-president and a member of the board of directors. Mr. Hoeveler has been actively engaged in illumination and electrical engineering since his graduation from the University of Wisconsin in 1911.

W. K. Yonge, who began service with the company as plant superintendent 21 years ago, has been named vice-president in charge of manufacturing. He continues as a member of the board of directors, to which he was elected in 1920.

H. C. Zinsmeister, auditor since 1934, has been appointed treasurer and elected to the board of directors and R. C. Fiske, who has served in a number of capacities, both at the office and in the factory since 1933 and during the past several years as secretary to the president, was promoted to secretary and elected a member of the board of directors.

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▶ P. R. CHAMBERS, operating manager of the Florida Power Corp., St. Petersburg, since 1937, has resigned.

▶ A. R. HATHAWAY, who has been connected with the Tampa Electric Co. since 1926, has been named secretary and treasurer to succeed the late Peter M. Miller. Prior to joining the Tampa utility Mr. Hathaway was connected with the Blackstone Valley Gas & Electric Co. at Pawtucket, R. I., and with the Puget Sound Power & Light Co. at Bellingham, Wash.

▶ ALBERT R. BECKERT, for the past ten years an engineer on the staff of the Thomson Research Laboratory of the General Electric Co. at Lynn, Mass., has been retired after 29 years of continuous service with the company. GEORGE D. HOYT, formerly assistant superintendent of the shipping department at the Pittsfield Works of the company and lately in the motor department at Lynn, has also been retired after 39 years of service.

▶ CLINTON E. STRYKER has been appointed vice-president and assistant to the president of the Nordberg Manufacturing Co. of Milwaukee, Wis., Mr. Stryker was a partner in McKinsey, Kearney & Co., management engineers of Chicago, having been connected with that firm for five years. Prior to that he was with Fansteel Metallurgical Corp. for a number of years in various administrative capacities. He was graduated from the Armour Institute of Technology in 1917. Mr. Stryker is a fellow of the American Institute of Electrical Engineers and a member of the Society of Automotive Engineers.

▶ A. R. SMALL, president of Underwriters' Laboratories, Inc., was elected president of the National Fire Protection Association at the recent meeting in Atlantic City.

▶ E. F. DETURK, formerly transmission and distribution superintendent, Metropolitan Edison Co., Reading, Pa., is now associated with the Long Island Lighting Co. at Mineola in the capacity of electrical engineer.

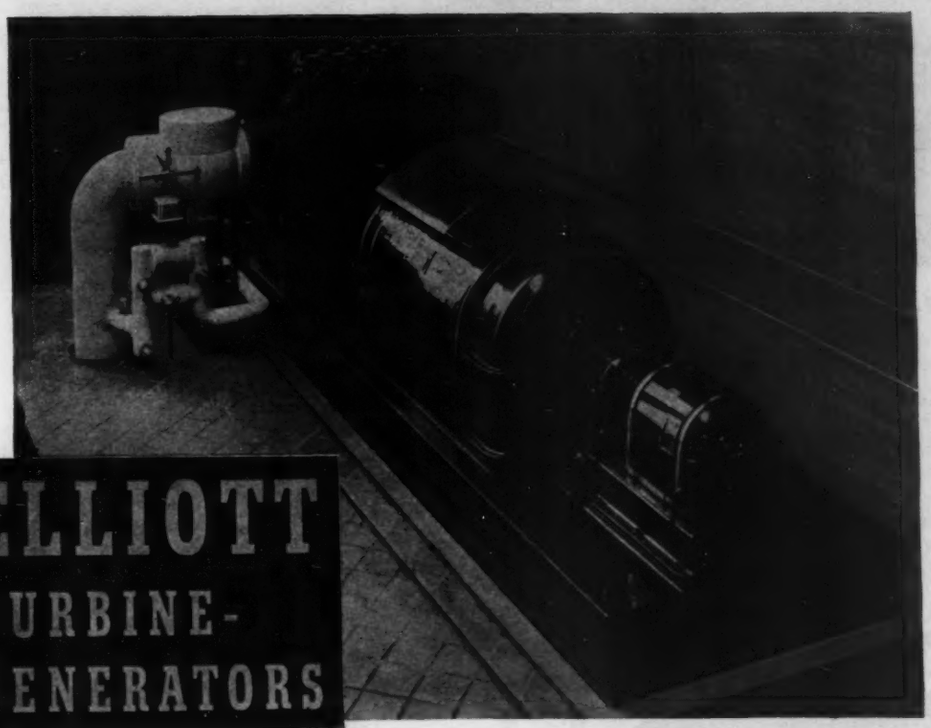
▶ C. A. COLLIER, vice-president in charge of sales of the Georgia Power Co., has been named by Gov. E. D. Rivers as Georgia's representative on the southern industrial mobilization committee for national defense.

▶ JAMES E. STODDART has been appointed manager of the Minot, N. D., division of the Northern States Power Co. Mr. Stoddart was appointed by Robert F. Pack, president of the company, to succeed John S. Hogan, who died July 18. Mr. Stoddart entered the employ of Northern States Power Co. in 1918 and has spent much of his time in North Dakota. For the last six years he has been assistant manager of the Fargo division.

▶ H. G. TAYLOR, electrical engineer for the Copper Development Association, London, England, has received the degree of doctor of science from London University. This degree was awarded in recognition of Mr. Taylor's work on grounding, the latest item of which was a joint paper, with several other engineers, which was read before the Institution of Electrical Engineers in London last February. Previously he was connected with the British Electrical and Allied Industries Research Association. He received his training at Vickers, Ltd., and Metropolitan-Vickers Electrical Co., Ltd.

▶ JAMES H. JEWELL has been appointed manager of agency sales by the Westinghouse Electric & Manufacturing Co. This department is responsible for the company's apparatus products sold through distributors. Mr. Jewell enrolled in the Westinghouse graduate student course in 1920. After completing the course in 1922 he was assigned to the small motor section at the East Pittsburgh Works. Then he went to Philadelphia as sales assistant, later became a salesman in the building section and, in 1930, was made

This quick-starting house unit gets station on line in **seconds** *rather than minutes!*



ELLIOTT
TURBINE-GENERATORS

Part of a line of dependable power plant equipment comprising:

MECHANICAL DRIVE TURBINES
STEAM ENGINES
ENGINE-GENERATORS
MOTORS
GENERATORS
MOTOR-GENERATORS
CONDENSERS
DEAERATORS
FEEDWATER HEATERS
DEAERATING HEATERS
STEAM JET EJECTORS
CENTRIFUGAL BLOWERS
DESUPERHEATERS
STRAINERS
GREASE EXTRACTORS
SEPARATORS
NON-RETURN VALVES
LAGONDA-LIBERTY TUBE CLEANERS

The Seal Beach Station, Los Angeles, serves as standby to hydro power. Its two main units total 81,250 Kva. It is extremely important to get them on the line quickly, when needed.

In order to speed up this operation the Elliott quick-starting, noncondensing 2500-kw. turbine-generator, illustrated, was installed. It is now a matter of seconds to pick up full load on a main unit, instead of the 30 to 45 minutes formerly required.

This quick-starting unit goes to work by an electrically operated start-up valve, remotely controlled. Flipping the control switch automatically starts the unit by admitting steam to a small turbine driving a vertical oil pump, and after oil pressure is obtained at bearings and governor, the main oil-operated throttle valve opens.

The Elliott turbine-generator is very smooth-running, and has proved its ability to carry overloads and go through difficult maneuvering without wavering. Requirements of the unit are that it must be able to absorb the load quickly, and when the load is dumped, the governor must be able to hold the speed steady.

Elliott Company is particularly well fitted to build small and medium-size turbine units of all kinds. This includes the complete range of sizes and conditions for mechanical drive turbines, and complete turbine-generators.

H-636

ELLIOTT COMPANY

Steam Turbine Dept., **JEANNETTE, PA.**
District Offices in Principal Cities

PAGE FENCE

IN THIS CASE, 97=100%

● Page Fence Association is composed of 97 factory-trained, long-experienced fence engineers in 97 cities. Each one a local firm permanently interested and responsible. That is 100% fence service—for you! Your local member will help you choose the right metal—right height—right style. He will erect the fence to give you enduring property protection and fine appearance.

Page Fence is available in 5 superior metals: heavily-galvanized copper-bearing steel—Armco ingot iron—Alcoa aluminum—Allegheny stainless steel—iron picket. Only Page makes fence of all five metals. The stronger winged-channel post is exclusive. Write to PAGE FENCE ASSOCIATION, Bridgeport, Conn., Atlanta, Chicago, New York, Pittsburgh or San Francisco for book, "Fence Facts."

A PRODUCT OF PAGE STEEL & WIRE DIVISION—AMERICAN CHAIN & CABLE COMPANY, INC.

America's First Wire Fence — Since 1883

DOUBLE DUTY **TONG TEST**

measures AC. and DC.

Tong Test was the first clamp-type ammeter. It is still the only instrument of its kind because Tong Test alone measures both A.C. and D.C. currents instantly and accurately. Also, exclusive with Tong Test are its instantly interchangeable meter dials. Having only one set of large numerals on each, these dials are furnished to meet your exact needs—up to 800 amperes A.C. and 400 amperes D.C.

Tong Test is small in size—weighs only 2¾ pounds and because it contains no windings, is the only ammeter of its type which can not burn out under overload or be damaged electrically.

Compare Tong Test's advantages with your present current measuring method. Send for prices and a copy of the Tong Test bulletin. You'll find both interesting.

COLUMBIA ELECTRIC MFG. COMPANY
4529 Hamilton Avenue
Cleveland, Ohio

manager of the construction industry section. After returning to East Pittsburgh in 1938 as manager of the public works and communications sections, Mr. Jewell was transferred to Philadelphia as manager of agency sales of the Middle Atlantic district. In 1939 he returned to East Pittsburgh as assistant manager of the agency sales department, the position he had held until now.

▶ J. K. Moore has been named Guthrie district manager of the Oklahoma Gas & Electric Co. to succeed W. H. Boasen, retired. Mr. Moore has been connected with the Oklahoma utility since 1920. His experience in the utility business includes a year with the San Diego Consolidated Gas & Electric Co.

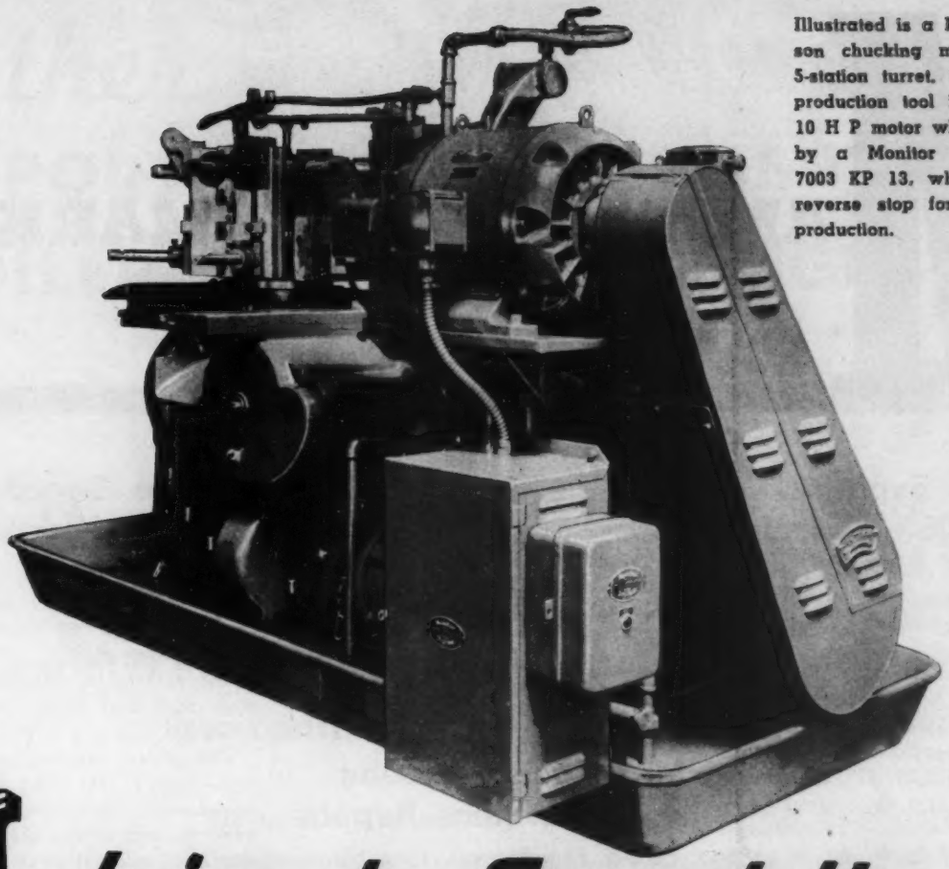
▶ Fred G. Starrett has been appointed manager of the Gresham division of the Portland General Electric Co., Portland, Ore., to succeed L. C. White, who has been transferred to the Portland office. Mr. Starrett was formerly division manager at St. Helens, Ore. E. R. Fletcher, who has been illuminating engineer in the Salem, Ore., division, was appointed division manager at St. Helens.

▶ L. W. Nims has been named special military and industrial mobilization liaison officer for the Utah Power & Light Co., with offices in Salt Lake City. Mr. Nims will have complete charge of directing the company's activities so as to provide ample supply of electric power for war industries, to render assistance to the military forces, to civic leaders in their defense problems and to business organizations in adjusting and increasing production for rearmament needs. For more than 30 years Mr. Nims has been connected with the Utah Power & Light Co. and predecessor company, Utah Light & Railway Co. He has been manager of the Ogden division since 1930.

OBITUARY

▶ Frank D. Powers, superintendent of electric distribution for the Fitchburg (Mass.) Gas & Electric Co. since 1923, died in that city on June 29, at the age of 65. He was a native of Belvidere, Ill., and had been in the employ of the company for 40 years.

▶ William E. Skinner, sales engineer in the railway department of the Northern States Power Co., Minneapolis, Minn., died July 16 at his home in that city. He had held the position he occupied at the time of his death since 1916. In the course of his career Mr. Skinner served as sales engineer and consulting engineer on many projects in the United States, Canada and the Hawaiian Islands.



Illustrated is a Potter and Johnson chucking machine with a 5-station turret. This high-speed production tool is driven by a 10 H P motor which is actuated by a Monitor Control, Model 7003 KP 13, which gives plug reverse stop for precise, rapid production.

Helping to Speed the National Defense Program

Type 6335 AA2 Thermaload Starter with unfused disconnect switch, showing the temperature-compensated thermal relay in use.

Machine tools by the thousands are being requisitioned for the vast armament program now under way—the finest, fastest tools ever built. And in this all-important undertaking production schedules will depend in a large part on the operating reliability of electrically driven machinery, which in turn depends on the reliability of motor control . . . Starting . . . Stopping . . . Reversing . . . Accelerating . . . Decelerating . . . Cutting out in case of dangerous overload . . . *All these functions are cared for directly by Monitor Controller, leaving the operator free to devote his skill where most needed—where tool meets work.*

Glad to consult with you to determine the most efficient and economical controller for your equipment . . . Write us today.

Monitor Controller Company

Gay, Lombard & Frederick Sts.

BALTIMORE, MARYLAND

Monitor TEMPERATURE COMPENSATED Thermaloads

MANUFACTURING - MARKETS

Electrical Exports Up 35% First Half

If there is no deceleration in trade during the closing half of this year American sales of electrical equipment may closely approximate the record all-time high of nearly $150,000,000 in 1929, according to the Electrical Division of the Department of Commerce.

Shipments abroad during the first six months totaled $71,207,425, an increase of 35.2 per cent over the corresponding period of 1939. Exports in June reached the highest monthly volume in years, totaling $12,984,343, an increase of 7.4 per cent over May and of 39.6 per cent over June, 1939.

Individual commodity increases and decreases were about evenly divided in June. June sales of rubber-covered copper wire, most strongly determining the favorable dollar balance, advanced from $1,319,492 in May to $2,397,425. During the same period foreign sales of weatherproof copper wire improved from $24,444 to $73,500, a figure more than double that of any other month this year. Foreign shipments of switchboard panels, except telephone, reached a new peak in June, when sales totaled $76,812, as compared with $45,253 in May.

•

Electrical Manufacturers Reduce Bad-Debt Losses

Net bad-debt losses of manufacturers of electrical machinery, apparatus and supplies averaged 0.09 per cent of their net credit sales in 1939, as compared with 0.12 per cent in 1938, according to a recent study reported in *Survey of Current Business*. For all industries reporting, net bad-debt losses averaged 0.17 per cent of their net credit sales in 1939, no change from the loss ratio of the previous year.

Net credit sales of the 90 reporting electrical manufacturers in 1939 were $453,383,000 out of a total net sales of $462,709,000, as compared with net credit sales of $390,003,000 and total net sales of $397,428,000 in 1938. For the total of 1,493 manufacturers reporting, net credit and total net sales were $4,075,805,000 and $4,507,429,000, respectively, in 1939, compared with similar figures of $3,625,666 and $4,047,515 in 1938.

•

Manufacturers Issue Earnings Reports

Net profit of the Electric Controller & Manufacturing Co. for the first six month of 1940 totaled $276,100, equal to $3.89 a common share. This compares with net loss of $11,269 for the first half of 1939 and net profit of $158,114, or $2.23 a share, for all of last year.

President F. R. Fishback stated that profit and loss surplus June 30 totaled $916,760, compared with $746,942 December 31, 1939. Dividends totaling $106,282 were paid or provided for during the first half. Current assets June 30 were $2,183,990, of which $1,316,956 was in cash and United States government securities. Current liabilities totaled $264,725.

Among the other electrical manufacturing companies issuing earnings statements are the following:

SQUARE D—Including Kollsman Instrument Co., six months to June 30, net profit, $905,130, equal, after preferred dividends, to $2.03 each on 421,360 shares of $1 par common stock. Net profit last year was $308,381, or 89 cents each on 343,860 shares of capital stock then outstanding.

ANACONDA WIRE & CABLE—Quarter ended June 30, subject to audit and year-end adjustments, net profit $367,979, or 87 cents each on 421,981 common shares, against $129,280, or 31 cents a share, in preceding quarter, and $131,293, or 31 cents a share, in like 1939 quarter. Six months ended June 30, indicated net profit $497,259, or $1.18 a share; for like 1939 period, $54,132, or 13 cents a share.

MCGRAW ELECTRIC—Twelve months to June 30: Net profit, $1,519,329, or $3.21 each, on 472,600 capital shares, compared with $1,107,006, or $2.34 a share, for the preceding twelve months.

Service Awards to 968 at Westinghouse

Employment records ranging from ten to 40 years have earned special service pins for 968 veteran employees of the meter division of the Westinghouse Electric & Manufacturing Co., more than half of the division's total personnel.

The group, representing a total of more than 17,000 years of service, received their pins from Tom Turner, works manager, who made the awards at a brief celebration in the recreation room of the plant. Mr. Turner is himself a veteran of eighteen years with the company.

Grand veteran of the day was 66-year-old Paul MacGahan, design engineer, who has been with Westinghouse for 44 years and who was among the group of four men cited for service of more than 40 years. They were: William Bradshaw, 67, manager of the engineering department; J. L. Cole, 61, chief testing inspector, and David Kulp, 60, sales department order correspondent. Mr. MacGahan joined the organization at East Pittsburgh, Pa., in 1896 at the age of 21 and recalls working on some of the first commercial electric meters in the United States.

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Type "SN" Wire Approved

Underwriters Laboratories, Inc., has extended approval to type "SN"—synthetic thin-wall—conductors. Types "RPT," "RHT" and "RU" were approved on July 1, but approval of the synthetic thin-wall type was delayed for completion of testing procedures.

•

Nash-Kelvinator Low Bidder

Sealed bids of sixteen companies to supply 4,917 electric refrigerators and as many cooking ranges for New Or-

Another

IMPORTANT DEVELOPMENT IN BOILER FEED PUMP DESIGN . . .

by Worthington

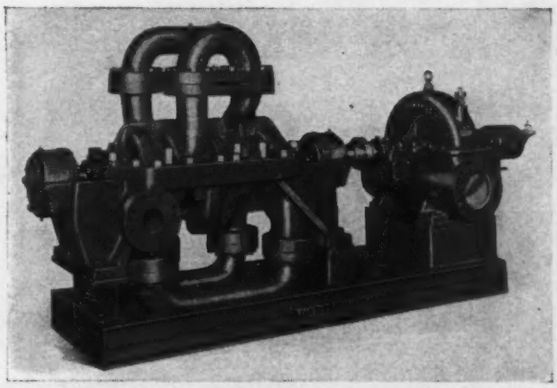
THE ELASTIC SEAL

(PATENT APPLIED FOR)

It eliminates inter-stage cutting . . . positively and permanently . . . in horizontally-split-casing centrifugal pumps

THE problem of sealing solid-ring inter-stage diaphragms against a horizontally-split centrifugal pump casing . . . so that the resulting joints are liquid-tight . . . has become increasingly difficult as stage pressures have been raised.

Both the diaphragms and the casing are necessarily rigid in construction and must seat tightly against each other. When the joints are not absolutely tight, the result is not only inter-stage leakage, but also the cutting of metal and the ultimate destruction of parts.



Worthington type UX centrifugal boiler feed pump equipped with THE ELASTIC SEAL

Worthington has now provided the solution to this problem. THE WORTHINGTON ELASTIC SEAL insures: First, the proper initial seating of the joints. Second, permanently tight seating through an arrangement whereby the pressure developed in each stage tends to seat each joint more tightly.

FOR the utmost reliability and lowest maintenance cost in centrifugal boiler feed pumps . . . always specify Worthington

WORTHINGTON PUMP AND MACHINERY CORPORATION
General Offices: HARRISON, NEW JERSEY
Branch Offices and Representatives in Principal Cities throughout the World

MEMBER

CPO-2

WORTHINGTON

Let this Trico Combination SAVE YOU MONEY!

Most fuse blowings are caused by FAULTY FUSES unmistakably poor in design, and BAD CLIP CONTACT. Stop this unjustifiable waste by using TRICO FUSES with self-contained *powder-packed*, tamper-proof and non-interchangeable renewal elements, and eliminate poor contact between fuses and clips with KLIPLOK CLAMPS.

KLIPLOK attached to a ferrule type clip. There's a size for every clip.

That powder-packed element means better fuse service.

Write for Folder 206-Y "The inside story of TRICO FUSES", and Folder 257 on KLIPLOK CLAMPS

TRICO FUSE MFG. CO., Milwaukee, Wis.
In Canada: IRVING SMITH LIMITED, Montreal

ELECTRITE

A high grade fibre board for electrical insulation. A material of quality possessing high tensile and dielectric strength. Used by many of the leading manufacturers of electrical equipment.

DENSITE

An extremely hard board of superior quality which can replace the more expensive types of insulating materials.

Pulp Products Department

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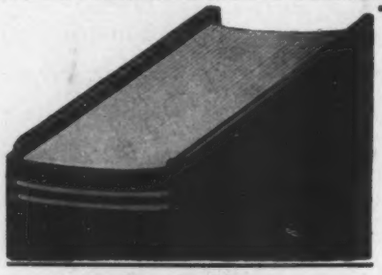

GENERAL ENGINEERING HANDBOOK

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leans' seven low-rent housing projects were opened July 25 at the city hall in that city. From base bids submitted, the Nash Kelvinator Company of Detroit was low on the "box" bid with $276,801. Awards will be made in the near future, the New Orleans Housing Authority, sponsor of the projects, announced.

•

Equipment Orders Placed for Boulder Project

Bureau of Reclamation, Denver, Colo., has awarded contract to the Moloney Electric Co., St. Louis, Mo., at $94,600 for four 13,333-kv., 60-cycle, single-phase, oil-immersed, water-cooled transformers, 16,320 to 79,677/138,000-volt and 39,838/69,000Y volts, for installation in Boulder power plant, Boulder Canyon project.

Under same specifications, award was made to Railway & Industrial Engineering Co., at $47,825, for one 16,500-volt, current-limiting reactor assembly for unit A-9, same power plant.

•

Navy Contracts Awarded

Bureau of Yards and Docks, Navy Department, Washington, D. C., has awarded a contract to Stone & Webster Engineering Corp., 49 Federal Street, Boston, Mass., for expansion and improvements in power plants at Boston Navy Yard and at submarine base, New London, Conn., including installation of equipment for increase capacities, at $1,325,000. Work is scheduled to be placed under way at once. This is part of a development program to be carried out at both places noted, with appropriations of $1,190,000 and $2,073,000 authorized for Boston and New London yards, respectively.

•

Canadian G.E. to Build

Canadian General Electric Co. at Peterborough, Ont., is working on plans for an addition to the local plant "to take care of considerable expansion of manufacturing facilities." Unofficial estimates place cost of the whole expansion project at about $1,000,000.

New York Metal Prices

	Aug. 6, '40 Cents per Pound	July 31, '40 Cents per Pound
Copper, electrolytic	11.25*	11.125*
Lead, A. S. & R. price	5.00	5.00
Antimony	14.00	14.00
Nickel, Ingot	35.00	35.00
Zinc, Spot	6.64	6.64
Tin, Straits	52.25	52.50
Aluminum, 99 per cent	18.00	19.00

*Delivered Connecticut Valley.

While there is time—

ONE THOUSAND PLANES A DAY: That kind of output is the symbol of the National defense program.

And we can do it — not only in planes but in tanks and guns and clothes and boots and all the thousand and one items that go to make up military procurement today.

[But we can not wait for new plants!]

And so, while there is time, let's immediately look into efficient multiple-shift operation for every present plant whether it is to handle National defense orders or is to take up the surge of other business. A prime requirement will be that night and day seeing conditions are equalized. Modern lighting developments hooked up with fresh painting make this a comparatively simple job — but this should be done now while equipment, time and labor can be allocated to it.

While there is time, let's see what can be done to simplify operations to avoid bottlenecks due to shortage of trained labor.

While there is time, let's look into flexible power distribution to permit quick layout changes without unnecessary interruptions.

While there is time, let's install protective lighting for plant exteriors, grounds and yards.

While there is time, (fantastic as the need may appear) let's think about operation under blackouts. This means not only adequate lighting but also ventilating and air conditioning for production under sealed-in conditions — A good investment in any case.

AND FINALLY, inform your power company of any contemplated additions to your requirements. Abundant power is available but in your own interests give the power company an opportunity to get the additional "copper" in time to arrange for adequate service on any increased needs.

"While there is time" is an editorial

from TIMELY IDEAS

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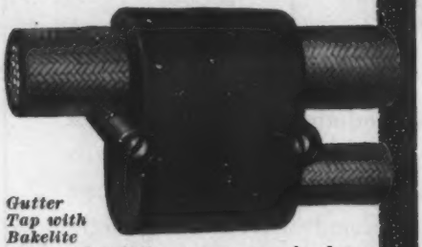
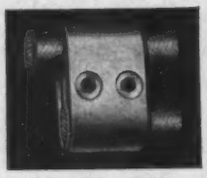
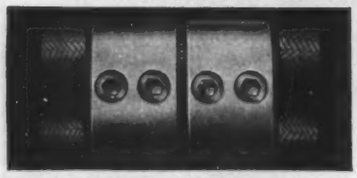


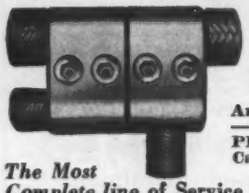
Gutter Tap with Bakelite Cover. Insulating covers can be furnished for all types of Penn-Union Cable Taps.



2-Way Gutter Tap; main and branch sizes 8 to 1,000,000.



Two Separate Parallel Taps to a continuous main conductor.



Combination Cable Tap; one branch tap parallel to main, and one at 90°.

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Field Reports on Business

Durable goods division of our economy continues under way with much heavy construction as represented by awards, but numerous consumer goods lines reflect the summer hiatus. Each week that passes without a total attack on the British Isles bolsters sentiment on this side.

NEW YORK

In the past week the nation moved nearer the solutions of such problems as peace-time conscription, new tax levies on war profits with war plant amortization allowances and government construction of plants ostensibly for private operation. In short, the nation is endeavoring to frame the rules under which the preparedness game is to be played.

Now building up under the surface is growing resentment against Administration refusal to permit settlement of plant amortization allowances by the Treasury so that airplane contracts, now "cleared" by Knudsen, will be signed and accepted by airplane manufacturers.

Analysis of durable goods shows tremendous impetus imparted by 72 per cent increase over preceding week and 89 per cent increase over 1939 week in heavy engineering contracts as announced by *Engineering News-Record.* Steel operating schedules are increased to 90½ per cent of capacity, a new 1940 high has been reached in electric output and lumber production is 12 per cent ahead of last week.

New orders are not being placed in the same volume, but heavy backlogs will load production facilities for months to come in electrical apparatus, steel, airplane, machine tools, shipbuilding and allied defense lines.

Most encouraging single development of the week was the buying wave in copper. Whether it carries on or not, supplies are shaded and pressure on prices eased. Fabricators' demand almost canceled a one-cent differential previously obtained by custom smelters.

At July 1 fabricators' unfilled orders rose to 231,000 tons, highest since February. These, added to an accumulation of 99.000 tons and another 312,000 tons on order, provide a coverage—on the basis of June delivery rates—into September and October.

CHICAGO

This area received military orders of considerable volume covering a wide range of material, including $3,188,999 for Diesel motors and high-speed earth-boring machinery which will be built by the Buda Co. of Harvey; $1,234,137 for medium, industrial type wheeled and heavy tractors for Allis-Chalmers at Milwaukee; $32,873 in tractors for International Harvester, Chicago, and a number of smaller contracts for cartridges, field range parts and quartermaster stores. Chicago has been tentatively chosen as the site for a $6,000,000 plant for forging and machining shells and there will be another of unspecified cost for the manufacture of optical instruments for the navy. Chicago area jobs and payrolls were up measurably. Department store trade and merchandise in general were good. Dealers and others in the trade got a break when the sustained high temperature opened up good business in electric fans. Rebuilt motors are moving again.

The steel industry maintained a swift pace. With the exception of the July 4 week operations were maintained throughout July at levels approximating practical capacity. The Chicago transit lines unification and modernization program moved closer to reality. It is understood that the Reconstruction Finance Corporation is preparing to offer a cash loan of 52 million dollars. Residential building activity is making a good showing.

PACIFIC COAST

Major construction is featured by government posts and bases, principally air. The $9,800,000 Alameda naval air station addition includes $150,000 for distribution system, $200,000 for power plant and $40,000 for radio facilities, plus wiring of individual buildings.

Industrial business includes lumber mill additions requiring new loads of from 1,000 to 2,000 hp. each; $10,000 fractional-horsepower pumping motors; three 333-kva. transformers, value $6,500, for a fruit packer; $9,000 arc-welding equipment, and $6,000 Pyranol transformers for Hawaiian sugar plantation. Three step-voltage regulators purchased by Pacific Gas & Electric Co. totaled $36,000. Los Angeles is receiving bids on a steam-generating unit for its Wilmington station. California mineral production declined 8 per cent last year from 1938, this fuel oil decrease being partially offset by increased gold production.

Retail electrical business is good, despite predictions of a prolonged marking-time period, and most manufacturers complain a shortage of the cheaper styles of their major appliances, especially refrigerators.

NEW ENGLAND

Activity in buying continues brisk under the stimulus of the defense program. Last week the War Department cleared contracts amounting to over $2.800,000 in Connecticut, of which $1.083,053 was an arms order placed with Colt's, Hartford; $13,528 worth of electric cable was bought from Rockbestos Products Corp., New Haven, and $12.059 was involved in motor-driven valves placed with Jenkins Bros., Bridgeport. Mystic Docks, Boston, have purchased a 35-ton Lambert electric crane equipped with G.E. motors, Simplex cable and with a 15-kv. Electric Controller electromagnet for handling scrap steel and iron. A 300-kva. G.E. transformer and Westinghouse oil circuit breaker have also been installed to serve this dock.

Metropolitan District Commission, Massachusetts, has ordered two DeLaval turbine pumps totaling 1,000 hp., equipped with G.E. synchronous motors, for a temporary sewage pumping station at East Boston.

Electric arc welders are moving rapidly, with the demand enhanced because of the establishment of about 50 special training schools in this district employing as part of their program these units. It is reported that more than 400 welders will be added to local shipyards this fall, insuring further demands for these units.

Lighting is forging ahead; Wakefield, Mass., has installed eighteen 1,500-watt G.E. floodlights at one of its playgrounds. A fluorescent installation consisting of 142 4/48-in. tubes and 400 single 40-watt tubes has been booked by a well-known pharmaceutical concern of Boston.

Over 50 foot-candles for Columbian Carbon Co. of N. Y.

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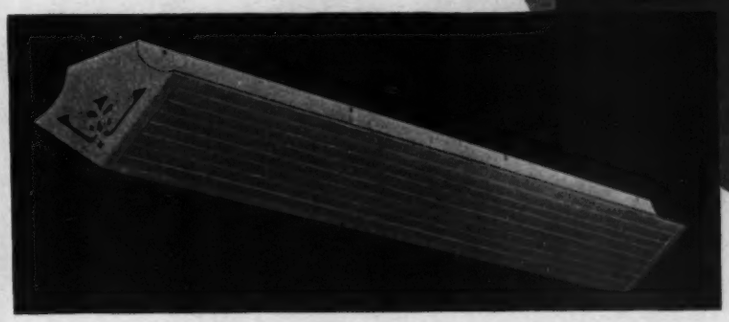
"L-I-N-O-L-I-T-E"

FLUORESCENT FIXTURES



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Features found in Barkon "L-I-N-O-L-I-T-E" Fixtures:

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- *Engineered for more comfortable vision*
- *Low surface brightness with maximum efficiency*
- *Steel construction*
- *Illumination on both working plane and upward towards ceiling*
- *Fluted ground glass diffuser panels*
- *Supplied complete with auxiliaries, sockets and starters*
- *Wired ready for installation*
- *Certified Fleur-O-Lier manufacturer*
- *Purchased by many utility companies*

When the Columbian Carbon Company of New York recently chose Barkon Frink *"L-I-N-O-L-I-T-E"* fluorescent fixtures, it was another proof point that the Frink Corporation has a common interest with utilities in providing engineered lighting . . . *adequate* lighting. This installation provides an average of over 50 foot-candles. The surface brightness of the fluted glass in the *"L-I-N-O-L-I-T-E"* unit is approximately ⅙th that of bare fluorescent tubes. In conjunction with air conditioning, it has made every portion of the floor area equally comfortable, equally desirable.

General acceptance of fluorescent lighting is growing *fast*. Barkon-Frink fixtures are available to meet every type of illumination need. They are corrected to near unity power factor, come completely equipped with auxiliaries, sockets and starters. They incorporate more than 80 years experience in lighting fixture manufacture. An impressive list of fluorescent installations attest the wide acceptance of Barkon-Frink "engineered for vision" fixtures. We design and produce every type of lighting equipment in our own factory, the largest of its kind. Also, to help you solve and execute your lighting problems, we maintain a complete engineering and designing service. Send the coupon for complete descriptive literature.

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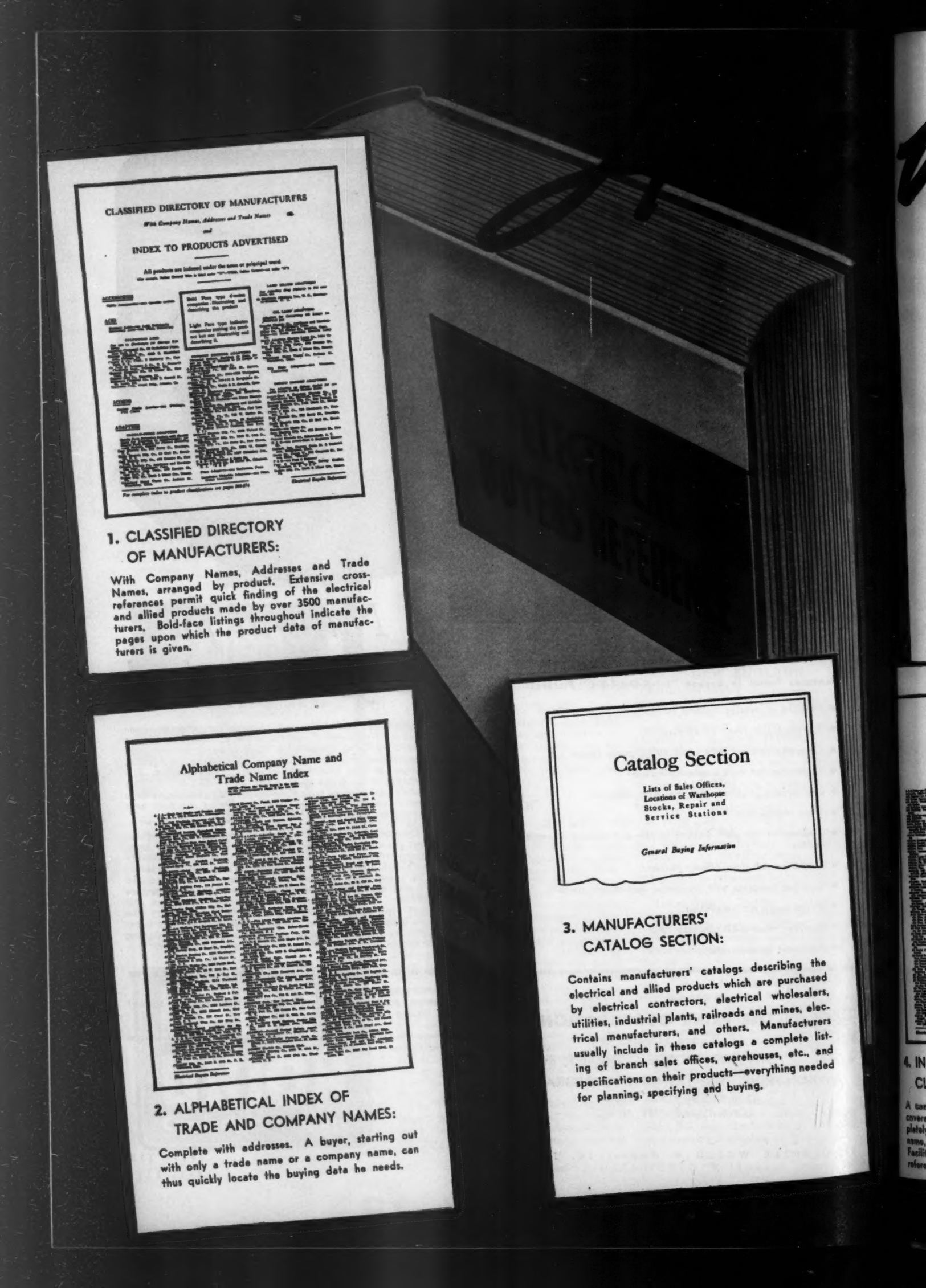
CLASSIFIED DIRECTORY OF MANUFACTURERS
With Company Names, Addresses and Trade Names
and
INDEX TO PRODUCTS ADVERTISED
All products are indexed under the name or principal word
Alphabetical Company Name and Trade Name Index
Catalog Section
Lists of Sales Offices, Locations of Warehouse Stocks, Repair and Service Stations
General Buying Information

1. CLASSIFIED DIRECTORY OF MANUFACTURERS:

With Company Names, Addresses and Trade Names, arranged by product. Extensive cross-references permit quick finding of the electrical and allied products made by over 3500 manufacturers. Bold-face listings throughout indicate the pages upon which the product data of manufacturers is given.

2. ALPHABETICAL INDEX OF TRADE AND COMPANY NAMES:

Complete with addresses. A buyer, starting out with only a trade name or a company name, can thus quickly locate the buying data he needs.

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Contains manufacturers' catalogs describing the electrical and allied products which are purchased by electrical contractors, electrical wholesalers, utilities, industrial plants, railroads and mines, electrical manufacturers, and others. Manufacturers usually include in these catalogs a complete listing of branch sales offices, warehouses, etc., and specifications on their products—everything needed for planning, specifying and buying.

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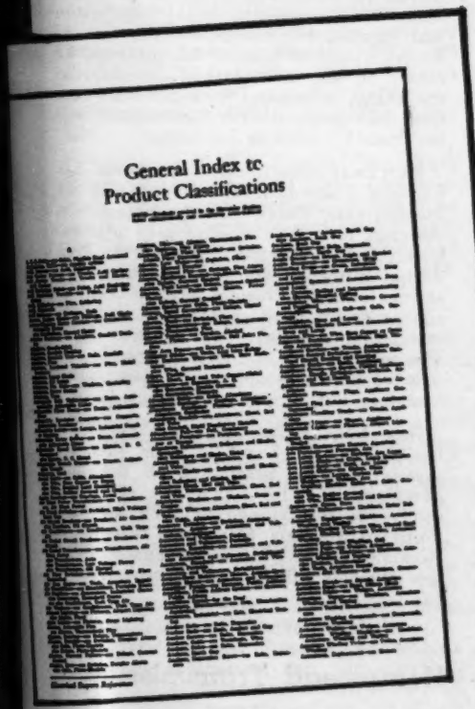

4. INDEX TO PRODUCT CLASSIFICATIONS:

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Send a wire or two
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For an old electrical gadget
Bought by a guy
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Aren't being rooked
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TIME--TEMPER--MONEY
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And finding the answer

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ELECTRICAL BUYERS' REFERENCE • 330 WEST 42 STREET • NEW YORK

WE'RE LOOKING FOR TROUBLE!

IF you use (or make) electrical equipment, your success depends upon the reliability of the vital sealing units used therein. So, in part, does your company's expense budget. For gasket failures cause power failures and downtime losses; or, if you're a manufacturer, gasket failures mean loss of customers.

Whether you use (or make) switches, bushings, transformers, cables, potheads, or circuit-breakers, our belief is that it will pay you to investigate Armstrong's Corprene. "Corprene" is the trade name for a group of more than two dozen cork-and-synthetic-rubber compositions—made in sheets, cut pieces, and molded forms. These materials are impervious to liquids and gases, and highly resistant to their destructive effects, also to those of sunlight and corona. Corprene seals can be depended upon to keep oil in and moisture out—*for the life of your equipment.* Furthermore, their physical characteristics (such as compressibility and lateral flow) are readily "tailor-made" to individual requirements.

That's why Westinghouse, for instance, uses Corprene gaskets in its transformers; and why Line Material Company protects the isolators in its lightning arresters with Corprene gaskets. And why *millions* of Corprene gaskets, packings, washers, and other sealing units are serving industry today—efficiently.

How to Quell a Sealing Quandary

If you are up in the air over any kind of problem related to electrical equipment seals—*tell us.* We're looking for that kind of trouble.

ARMSTRONG'S *Corprene*

ARMSTRONG CORK COMPANY
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Recent Rate Changes

BOSTON EDISON CO. will establish on October 1 a general rate reduction aggregating $600,000 per year, by approval of the Massachusetts Department of Public Utilities, which has been in conference with President Frank D. Comerford and other members of the utility organization for some time. The cut is voluntary. In offering the reduction, Mr. Comerford said that war conditions, increased cost of materials, the large increase in taxes and similar items have made it difficult for the company to commit itself to a rate readjustment program at this time. "We feel, however," he declared, "that after adequate reserves for depreciation, employees' annuities, further added taxes and costs, reductions in our rates aggregating not less than $600,000 a year may be made available by schedules to be filed before Sept. 3. . . . Of course, general conditions are so unsettled that this policy must be subject to unforeseen adverse factors of a general nature." Chairman Joseph P. Cotton of the commission announced the board's willingness to allow the above reduction on a tentative basis until March, 1941, or later, as experience under the new schedule and the trend of general business conditions may make advisable. He stated that the commission was fully cognizant of the changes in the business situation since May, and realizes that the company faces substantial increases in operating expenses, notably in taxes and costs of material. Chairman Cotton further pointed out that the present schedule compared with that in effect in 1929 represents a saving to customers of approximately $5,000,000 a year. He paid a tribute to the co-operation of the company in the inquiry by the board.

NARRAGANSETT ELECTRIC CO. customers and those of the Blackstone Valley Gas & Electric Co. will save $367,500 annually under new electric rate schedules to become effective October 1, following negotiations with Public Utilities Administrator Benjamin M. McLyman at the state capitol. Narragansett rates will be cut $274,000 and Blackstone Valley rates $93,500. Last fall Narragansett reduced its rates by $500,000 per annum and Blackstone by $125,300. Commissioner McLyman said that these later reductions form the second step in a program ending October 1, 1942. The first two steps represent a total reduction of about $1,111,000 in annual bills for electricity. The Narragansett rate reductions will be spread over several schedules. Customers using from 6 to 200 kw.-hr. per month will benefit by $68,000. Negotiations are still in progress between the commission and the Newport Electric Corp.

PENNSYLVANIA EDISON CO. was ordered by the state Public Utility Commission on July 24 to file within 15 days schedules for its electric residential and commercial consumers calculated to effect a reduction of not less than $229,700 annually in gross operating revenues. The new schedule is to be effective for all billings resulting from meter readings after August 31. Schedules are also to provide objective residential and commercial rates, effective immediately for such customers as increase their consumption of energy and applicable to all customers on September 1, 1943, effecting further reductions estimated at approximately $219,100. The utility is also asked by the commission to file with it copies of all contracts for public street and highway lighting service, together with a uniform schedule of work for this service; to file a copy of its monthly operating statement in order that the commission may determine the effect of the ordered reductions, and to advise the commission monthly as to the number of each class of customer in each rate area billed under the immediate rate provisions and under the objective rate provisions.

PUGET SOUND POWER & LIGHT CO. has announced that the new residential rate reductions for electric energy, effective on meter readings after July 15, have been approved by the Department of Public Service. The new rates will be effective in the Seattle metropolitan area, including Renton, and will save customers $115,000 annually. On the same date, a downward rate revision announced in May by Seattle City Light became effective. The utility's new schedule cuts present charges of 4½ cents per kilowatt-hour for the first 40 kw.-hr. of consumption per month to 3½ cents per kilowatt-hour for the first fifty kw.-hr. President Frank McLaughlin of the utility company declared that his company's new rates match those announced by the city plant.

PORTLAND GENERAL ELECTRIC CO. has filed a new industrial power tariff with the Oregon Public Utilities Commissioner, resulting in a saving of approximately $100,000 annually for five pulp and paper customers. The new rate, quoted for industrial concerns with a demand of 3,000 kw. or more and served at voltages above 50,000, is the same as Bonneville's alternate wholesale power rate, which is 75 cents per kilowatt of billing demand per month plus energy charge of 2½ mills.

WISCONSIN PUBLIC SERVICE CORP. has been authorized to reduce residential electric rates approximately $40,000 annually for 42,000 home users in 145 communities. Under the new schedule in the larger cities and villages, the charge for the first 50 kw.-hr. is reduced from 4.7 cents to 4.5 cents; in the next largest communities the charge is reduced from 5.5 cents to 5 cents and in the smaller communities it is cut from 5.7 cents to 5.5 cents.

BROCKWAY LIGHT, HEAT & POWER CO. has filed a new schedule of rates with the Pennsylvania Public Utility Commission designed to reduce electric bills approximately $7,817, effective September 1. Residential customers will share a total annual savings of approximately $3,552; commercial consumers will save $2,944 and general power customers approximately $603. The remainder of the total savings is distributed among customers in other classifications.

NEW YORK PUBLIC SERVICE COMMISSION has granted the Board of Light Commissioners of Ilion permission to put into effect revised rates which will save consumers in the Village of Ilion and the towns of German Flatts and Frankfort, Herkimer County, $4,652 per annum. The new schedule will become effective August 15.

•

Hempstead Transmission

The City Council, Hempstead, Tex., has awarded contract to the Taylor Construction Company, Taylor, Tex., for new transmission line from municipal limits to Bellville, about 15 miles, where service will be furnished. Garrett Engineering Company, Houston, Tex., is consulting engineer.

Sales Opportunities

JACKSON, MICH.—Consumers Power Co. has approved plans for extensions in primary and secondary lines in parts of seven counties served by company, totaling close to 43 miles in all, for expansion in rural electric system, including transformers, service facilities, meters, etc. Work is scheduled to begin soon.

VALPARAISO, NEB.—Village Council has plans under way for modernization and improvements in municipal electrical distribution system, recently acquired from Iowa-Nebraska Light & Power Co. Bids will be asked at early date. H. H. Henningson Engineering Co., Service Life Building, Omaha, Neb., is consulting engineer.

PORTLAND, ORE.—Administrator, Bonneville Project, Department of Interior, 811 N.E. Oregon Street, Portland, receives bids until August 22 for 45,000 insulators for various lines of Bonneville transmission system (Circular 1226).

MADISONVILLE, KY.—City Council plans new municipal power plant. Cost estimated about $450,000 and bond issue will be arranged in that amount. Burns & McDonnell Engineering Co., 107 West Linwood Boulevard, Kansas City, Mo., is consulting engineer.

CAMDEN, N. J.—R. M. Hollingshead Co., manufacturer of polishes, paint compounds, etc., plans installation of motors and controls, duct lines, regulators, conveyors and other equipment in connection with proposed rebuilding of plant occupying block bounded by Ninth, Tenth, Cooper and Market Streets, recently destroyed by fire. Loss estimated over $600,000.

BELVIDERE, ILL.—Illinois Northern Utilities Co., Dixon, Ill., plans new one-story service and operating building, 64 x 106 ft., on Whitney Avenue, Belvidere, with equipment storage and distributing department, meter division and other facilities.

SYRACUSE, N. Y.—Central New York Power Co. has approved plans for extensions and improvements in underground conduit system in business district, including line replacements, new connections and other work. Program will begin soon. Cost reported over $80,000.

BIRMINGHAM, ALA.—Reynolds Metals Co., Inc., 810 East Franklin Street, Richmond, Va., manufacturer of metal foils, etc., plans installation of motors and controls, transformers and accessories, duct lines, switchgear, conveyors, electric hoists and other equipment in proposed new plant for production of aluminum in Northern part of Alabama, vicinity of Birmingham or Sheffield, where several sites are under consideration. New mill will be electrically-operated throughout and contract will be made for TVA power supply for this service. Transmission line will be built from connection with TVA system to plant site, where power substation will be built. A considerable part of output is scheduled to be for government use. Company has concluded arrangements with RFC for loan of $15,800,000 to carry out project. Work will proceed at early date, with completion early in 1941. Company also will install industrial electrical equipment in proposed addition to tin and aluminum foil plant at Richmond. Cost estimated over $200,000.

VIENNA, MD.—Delmarva Power Co. has plans maturing for extensions and improvements in local generating station, including installation of additional equipment. Bids for building erection are being asked and work will be placed under way at early date. Utility Management Corporation, 61 Broadway, New York, N. Y., is consulting engineer.

CHICAGO, ILL.—Signal Corps Procurement District, 1819 West Pershing Road, Chicago, receives bids until August 26 for twelve switchboards, quantity of junction boxes, cabinets, binding post assemblies, panels and other apparatus (Circular 42).

TRENTON, MICH. — Monsanto Chemical Co., 1700 South Second Street, St. Louis, Mo., manufacturer of industrial and other chemical products, plans installation of motors and controls, transformers and accessories, regulators, duct lines, switchgear, conveyors and other equipment in new multi-unit plant at Trenton, where tract of about 175 acres of land, fronting on Detroit River, has been acquired. New plant will be used for production of sodium phosphate and allied specialties. Cost reported over $1,000,000. Proposed to begin work soon.

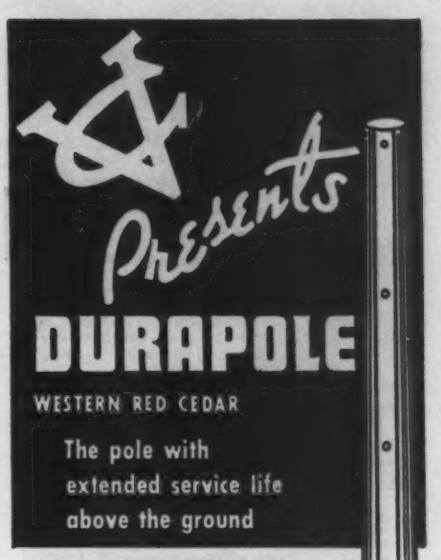
CHARLESTON, S. C.—South Carolina Public Service Authority, Charleston, receives bids until September 6 for construction of superstructure for Pinopolis hydroelectric power plant, including main building, lock house, elevator house and utilities building, and furnishing and installing certain mechanical power station equipment, such as air compressors, water pumps, oil pumps, oil purifiers, piping, valves and accessory apparatus. Plant is located about 32 miles from Charleston, and is part of Santee-Cooper power project, on which work has been in progress for number of months. Harza Engineering Company, 27 Cumberland Street, Charleston, is consulting engineer; bids are scheduled to be received at latter office.

LOS ANGELES, CALIF. — Los Angeles Water and Power Bureau, 207 South Broadway, has plans nearing completion for new load dispatchers' headquarters building at 115 South Boylston Avenue, 65 x 132 feet, and 35 feet high, and will take bids soon on general erection contract. Cost estimated close to $75,000, including electrical equipment.

MINNEOTA, MINN. — City Council will take bids at once for new municipal power plant, including generator unit and complete auxiliary equipment. Also for electrical distribution system, G. M. Orr & Co., Baker Arcade Building, Minneapolis, Minn., are consulting engineers.

PORTLAND, ORE.—R. N. Chipman Chemical Co., Railroad Avenue and Middlesex Boulevard, Bound Brook, N. J., manufacturer of chemicals for weed elimination, industrial chemicals, etc., plans installation of motors and controls, duct lines, switchgear, conveyors and other equipment in new addition to branch plant near Portland, for production of sodium chlorate and allied products. Cost reported over $200,000. Erection is scheduled to begin at early date.

ABERDEEN, WASH.—Grays Harbor Public Utility District, Aberdeen, has plans under way for extensions in transmission line to Ocean City, including connection with Bonneville transmission system and expansion in power substations for increased service.



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Slattery Announces Rural Allotments

Allotments totaling $6,278,000 for rural electrification in 29 states were announced by Harry Slattery, Administrator of Rural Electrification, during the last week in July. These allotments provide for the establishment of new systems and the enlargement of others. They bring the total loans approved by REA since its establishment in 1935 to $294,156,114.

Among these recent loans are the following:

ALABAMA — Clarke-Washington Electric Membership Corp., Jackson, S. E. Kyser, supt., $94,000 to build 120 miles of line, 292 members in Clarke, Washington, Wilcox and Monroe counties.

ARKANSAS—Mississippi County Electric Co-operative, Inc., Blytheville, H. C. Knappenberger, supt., $97,000 to build 105 miles of line, 429 members in Mississippi County.

COLORADO—Intermountain Rural Electric Assn., Bailey, J. R. Maile, supt., $221,000 to build 227 miles of line, 585 members in Douglas, Park, Teller, Jefferson and Clear Creek counties.

GEORGIA — Rayle Electric Membership Corp., Washington, Wilfred B. Smith, supt., $375,000 to build 417 miles of line, 1,523 members in Wilkes, Lincoln, Oglethorpe, Hancock, Greene, Taliaferro and Morgan counties. Irwin County Electric Membership Corp., Ocilla, W. A. Tankersley, Jr., supt., $154,000 to build 180 miles of line, 602 members in Berrien, Irwin, Ben Hill, Turner and Wilcox counties.

IDAHO—Clearwater Valley Light and Power Assn., Inc., Lewiston, A. R. Mushlitz, supt., $192,000 to build 135 miles of line, 248 members in Clearwater, Latah, Lewis, Nez Perce counties, Idaho, and Asotin County, Wash., and the Town of Anatone, Wash.

ILLINOIS—Shelby Electric Co-operative, Shelbyville, Lester Boys, supt., $189,000 to build 253 miles of line, 799 members in Macon, Christian, Montgomery and Shelby counties.

INDIANA—Dubois Rural Electric Co-operative, Inc., Jasper, Peter L. Friedman, president, $322,000 to build 351 miles of line, 1,219 members in Dubois and Crawford counties. Southern Indiana Rural Electric Co-operative, Inc., Toll City, Emil Brinkman, president, $355,000 to build 385 miles of line, 1,379 members in Perry and Spencer counties.

IOWA—T.I.P. Rural Electric Co-operative, Brooklyn, Irving L. Nervig, manager, $160,000 to build 180 miles of line, 396 members in Iowa, Tama, Keokuk, Poweshiek and Benton counties. Grundy County Rural Electric Co-operative, Grundy Center, R. F. Cramer, supt., $120,000 to build 140 miles of line, 288 members in Tama, Grundy, Marshall and Butler counties.

KANSAS—Butler Rural Electric Co-operative Assn., Eldorado, W. B. Brown, supt., $254,000 to build 310 miles of line, 597 members in Butler, Harvey and Sedgwick counties.

LOUISIANA—Claiborne Electric Co-operative, Inc., Homer, W. M. Rainach, supt., $134,000 to build 168 miles of line, 502 members in Claiborne, Webster and Union Parishes, La., and Columbia County, Ark.

MICHIGAN—Top O'Michigan Rural Electric Co., Boyne City, LeRoy Hardy, supt., $266,000 to build 302 miles of line, 905 members in Antrim, Kalkashka, Otsego, Emmet, Montmorency, Grand Traverse, Cheboygan and Charlevoix counties.

MINNESOTA—Lage Region Co-operative Electrical Assn., Pelican Rapids, Albert R. Knutson, supt., $137,000 to build 177 miles of line, 439 members in Grant, Otter Tail and Wilkin counties. Carlton County Co-operative Assn., Kettle River, M. O. Wilson, manager, $102,000 to build generating plant.

MISSISSIPPI—Delta Electric Power Assn., Greenwood, Robert F. Harrison, supt., $140,000 to build 179 miles of line, 819 members in Sunflower, Bolivar, Holmes, Tallahatchie, Washington, Leflore and Humphreys counties.

MONTANA—Big Horn County Electric Co-operative, Inc., Hardin, Carl J. Sloan, president, $188,000 to build 157 miles of line, 492 members in Big Horn County.

OHIO — Carroll Electric Co-operative, Inc., Carrollton, Harry Merrick, supt., $261,000 to build 279 miles of line, 932 members in Carroll, Columbiana, Tuscarawas, Jefferson and Harrison counties.

OKLAHOMA—Alfalfa Electric Co-operative, Inc., Cherokee, Howard Crocker, manager, $107,000 to build 151 miles of line, 297 members in Alfalfa, Grant and Major counties, Okla., and Barber and Harper counties, Kan.

OREGON—North Douglas Electric Co-operative, Inc., Roseburg, M. L. Hallmark, attorney, $177,000 to build 172 miles of line, 375 members in Douglas County.

PENNSYLVANIA — Northwestern Rural Electric Co-operative Assn., Inc., Meadville, Bruce V. Hecker, supt., $200,000 to build 192 miles of line, 769 members in Erie and Venango counties.

SOUTH CAROLINA—Santee Electric Co-operative, Inc., Kingstree, Walter E. Blackwell, supt., $340,000 to build 365 miles of line, 1,530 members in Williamsburg, Georgetown, Florence and Clarendon counties.

TEXAS—Bartlett Electric Co-operative, Inc., Bartlett, R. W. Miller, supt., $56,000 to build 76 miles of line, 193 members in Bell, Milan and Williamson counties.

VIRGINIA—Northern Neck Electric Co-operative, Warsaw, R. R. Denison, supt., $66,000 to build 60 miles of line, 219 members in Westmoreland, King George, Stafford, Richmond and Northumberland counties.

WASHINGTON—Nespelem Valley Electric Co-operative, Inc., Nespelem, Jacob M. Koontz, president, $106,000 to build 49 miles of line, 625 members in Okanogan County.

•

New Boston Edison Paper

"Edison News", a monthly magazine for Boston Edison employees, made its appearance on July 1, following an interim of some months after the discontinuance of "Edison Life", a bi-monthly well known to the power industry. Important events within the company and personal notes which may interest employees will feature the new periodical, which is a well-illustrated 20-page sheet of diversified material ranging from engineering and sales to happenings concerning individuals, accident prevention, operating information, finances and many other topics. T. H. Carens, vice-president, is chairman of an editorial board of nine.

LETTERS TO THE EDITOR

Pioneer Wants to Help With History

To the Editor of ELECTRICAL WORLD:

Refer to A.I.E.E. *Electrical Engineering*, June, 1940, page 226, quoting your editorial of January 27, 1940.

If possible, I believe that we should attempt the history suggested. I believe it should be written in sections. One section should be on the utilization of electric power. I grew up in this field with Westinghouse, as your editors will remember. I will be glad to help any one who undertakes to write this section. I no longer have the facilities that I had at Westinghouse to undertake work of this kind, but I can spare some of my time to help another.

H. D. JAMES,
Pittsburgh, Pa.

[Mr. James is typical of a large number of men who grew up in the industry. Their experience is a vast storehouse not only of fact but of background behind the trend of our developments. This background, largely existent only in the minds of such men, is of much greater importance in guiding future trends than a mere record of events.—EDITORS.]

•

Appeasement Does Not Pay

To the Editor of ELECTRICAL WORLD:

Your editorial "Why Take It Lying Down?" in the May 15 issue of the WORLD, inspires me to write you with the hope that my comments may prove of some constructive value.

Your editorial states: "Major policy matters may be decided by men of mature judgment, but the bulk of operations of that agency (S.E.C.) appear to be left in the hands of young attorneys, many of whom have never had a particle of previous experience or business contact." This is a very charitable understatement of fact.

Mature judgment can be exercised only by those persons having had full experience, regardless of the person's age. There are a number of experienced men on the staff who are capable of exercising sound judgment; some with titles that would indicate they held key positions, and these men desire to do an honest and constructive job. The fact is, they are seldom consulted, and upon those rare occasions when they are, little attention is given to their opinions. The mere fact that they have been connected with business and are experienced makes them suspects in the eyes of the New Dealish majority.

Regardless of title, there is hardly a man in a key position, having had previous public utility experience, who is allowed to function. It is safe to say that if it were not for the economic necessities of the individual, every sound-thinking man of experience in the public utility division would resign tomorrow.

There is such widespread blind fear among the utilities that it is practically impossible for these capable men to find other employment. The result is a growing belief on the part of many of these men that they must go along with any program suggested by those in key positions, regardless of how punitive and destructive it may be; otherwise, they run the risk of subjecting their families to the terrors of unemployment.

The utilities could and should do something to relieve this situation. Unless they do, or unless there is a change in the Administration, the utilities will find themselves in even greater difficulties. There is much talk these days about subversive influence. Here is an excellent example, in the government itself, and I am sure it is not the only one.

The utilities have unwittingly contributed to their own difficulties. They have accepted compromises, which doubtless seemed to them in individual cases to be expedient, at the time, instead of courageously standing on the principles involved. They have not realized to what extent these compromises are capitalized by individual staff members for purposes of personal advancement. The practice is actually encouraged. Having once scored a point, an attempt is made to apply the same theories in every similar case. The result is cumulative, with a constantly increasing burden upon all companies.

Another result is that staff members have learned that even though they personally are inclined to resist the attempt by others to apply these theories, it is futile to do so, because when the company involved, as a matter of expediency, capitulates, it leaves the staff member in an embarrassing position.

Considered from a broad and long range viewpoint, this policy of following the dictates of expediency will result in a very great burden upon the industry. To resist may be costly in a particular case, but the aggregate cost will be far less, and ultimately the industry will be able to move with

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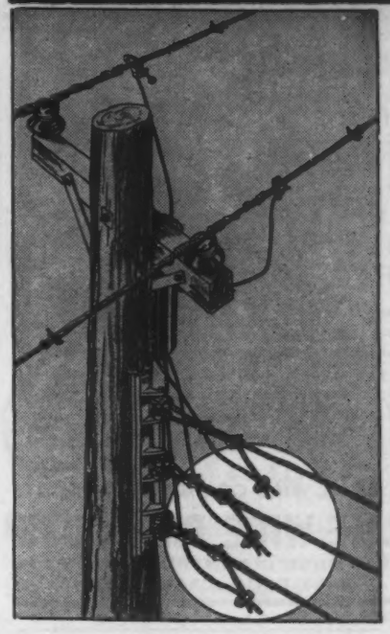

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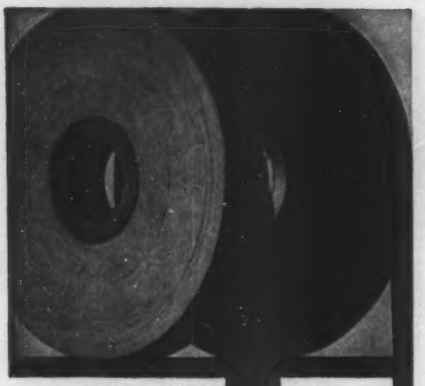

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greater freedom. The world has just learned by bitter experience that appeasement does not pay. The utilities might take this lesson to themselves.

FAIR PLAY.

[This is not an anonymous letter. The writer, who is known to us, is in a position to speak accurately.—EDITOR.]

•

52 Years a Subscriber—Is This a Record?

To the Editor of ELECTRICAL WORLD:

I began taking the WORLD at the beginning of 1888, when I was a very young man, carrying the responsible job of superintendent and electrician of a very early Edison central station (Piqua, Ohio). An article in the WORLD by Tesla on his development of polyphase systems revealed my need for mathematics. Ten years later I entered the electrical engineering course at Ohio State University, with very little money but a great thirst for knowledge. I kept up my subscription to the WORLD during my five years there, in spite of the frequent doubt as to where the next meals would come from. I graduated in 1903 with an appointment to the National Bureau of Standards in my pocket. My subscription to the WORLD has never been broken.

I believe I can qualify in a competition to see which of your subscribers has the longest unbroken record.

H. B. BROOKS,
Consulting Electrical Engineer
Washington, D. C.

[NOTE:—We would be glad to hear from any subscriber who can equal or better this record of more than half a century as a reader of ELECTRICAL WORLD.—EDITOR.]

•

Seattle City Light Shows Increased Usage in Year

Consumption of electrical energy by customers of Seattle City Light in the year ended May 31 was more than 387,000,000 kw.-hr., an increase of 35,000,000 kw.-hr. over the preceding year, according to Superintendent E. R. Hoffman.

There were 101,743 meters on City Light lines during the fiscal year, an increase of 2,785; revenues totaled $6,136,903, an increase of $129,076, and direct taxes totaled $345,531, an increase of $7,795. Merchandise sales totaled 545,517, an increase of $39,420. The 38,448 electric ranges in use represented an all-time high and an increase of 3,102 over the previous year.

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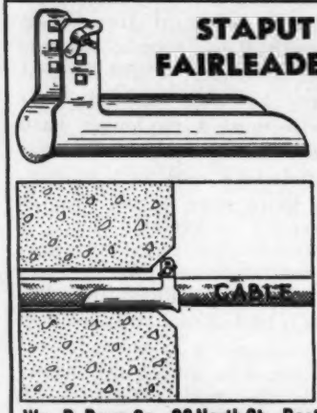

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A Capacitor Program for Distribution Betterment

[*Continued from page 48*]

Since I is constant for any given transformer, and the expression within parentheses approaches a value of 2.0 under typical conditions, the order of I_c for complete elimination of the dip is about $2I$, or sufficient to give a corrected power factor near 50 per cent leading at full load.

The two charts of Fig. 3 show "before and after" conditions in an actual case. In this instance complete elimination of the drop would have required 61 kva. of capacitors; however, correction to 120 volts was deemed sufficient, and 45 kva. (nameplate rating) was actually installed.

Adjustment of Compensator

When large installations are made to postpone installation of other plant or to reduce voltage drop in the feeder it frequently becomes necessary to make adjustments in the compensator setting. This is particularly true if the point of attachment is carefully chosen to give maximum reduction of annual copper losses. As will be discussed in a subsequent article, the characteristics of typical circuits in Public Service territory are such that maximum reduction in losses is obtained by installing capacitors equal to about 40 per cent of the average weekday peak load in the circuit at point of attachment, and since banks smaller than 180 kva. involve a penalty in cost per kva. installed, these large installations are not made at the ends of the circuit, but at or shortly beyond the first feed point, or end of the feeder.

Now, if it is the practice to provide some degree of over-compensation—that is, if the voltage at the end of the feeder is not maintained at a constant level, but rises with increased circuit loads—attachment of capacitors at the end of the feeder may result in a small deficiency in the voltage supplied. This is because the capacitor reduces the voltage drop in the feeder only from substation to the point of its attachment, while the compensator "thinks" the voltage improvement is effective throughout the whole circuit by reason of a general improvement in power factor and reduction in peak amperes.

The remedy is to increase the no-load setting of the contact-making voltmeter by an amount equal to this deficiency, retaining the original R and X settings of the compensator. This increase in the no-load spring setting can be quickly approximated by the following calculations:

(1) X setting of compensator = (Feeder reactance, in ohms, + Reactance of overcompensation, in ohms) k, where k is the constant for converting circuit ohms to compensator points for the particular equipment involved, as discussed below.
(2) Fixed voltage boost due to capacitor, in general = I_cX
(3) Voltage rise which the compensator "thinks" has resulted from the capacitor = (Feeder reactance + Reactance of overcompensation) I_c
(4) But the actual voltage rise resulting from the capacitor = (Feeder reactance) I_c.
(5) Deficiency = (3) minus (4) = (Reactance of over-compensation) I_c.

Reactance of Over-Compensation

If it is company practice to compute compensator settings from circuit characteristics, this "reactance of over-compensation" is a known quantity. If settings are not calculated, but based on field checks of voltage, it may be determined from equation (1) by inserting the known compensator setting which was established by trial before adding the capacitors, as well as the feeder reactance which is easily determined, and solving for "reactance of over-compensation" by difference.

The factor k in equation (1) is determined from the characteristics of the feeder equipment as follows:

Let P = potential transformer ratio for compensator circuit
C = current transformer ratio for compensator circuit
W_s = reactance per step in compensator

Then $k = \dfrac{C}{W_s P}$

For a standard 300-amp. equipment, if $P = 20/1$, $C = 60/1$, and $W_s = 0.2$ ohm,

then $k = \dfrac{60}{0.2 \times 20} = 15.$

The reactance of over-compensation for a given system is dependent upon the permissible variation from the nominal standard voltage and the apportionment of voltage drop in the various components of the distribution plant. For the Public Service system the value usually taken for this quantity is $\frac{84}{I}$, where I is the normal (pre-holiday) December peak on the circuit, in amperes per phase. The order of the recommended increases in no-load spring setting of

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the contact-making voltmeter, under these conditions, is shown in Fig. 4.

In connection with this practice of locating the capacitors near the first feed point it must not be overlooked that the impressed voltage at time of peak on a nominally 2,400-volt circuit will approach 2,500 volts. Since the shunt capacitor rating is 2,300 volts and its effective kva. varies as the square of the voltage, 1.18 times nameplate rating is actually realized.

A subsequent article will discuss capacitor installations to reduce energy losses, to postpone plant additions and meet war production loads.

Flexible Steam Provisions For Combination Turbine

[*Continued from page 65*]

sq.ft. Steel construction is used for shell, water boxes and tubes. The condenser and its auxiliaries was furnished by the Worthington Pump & Machinery Corporation.

Circulating pumps are vertical axial flow type. The condenser under the 32,000-kw. unit in this plant is served by three 28,500-g.p.m. circulating pumps, two of which were necessary to supply maximum water required by the condenser. The third circulating pump, therefore, was removed and the two new vertical circulating pumps installed in its place. The flow in the creek at extreme low does not supply sufficient water for the condenser without recirculation.

In order to insure that the maximum capacity of the station when required would not be limited by circulating water, and to improve vacuum conditions to produce increased economy during the summer months in normal operation, it was found desirable to install a cooling tower to operate in conjunction with the cooling pond formed by the dam across the creek. It was not found economical to install cooling tower capacity sufficient to take care of all the circulating water requirement.

Electrical System

The cooling tower is of the induced-draft design and has a capacity of 28,500 g.p.m. The tower is located at approximately the elevation of the turbine room floor. This makes it necessary to use a booster pump in series with the circulating pumps to force water to tower.

All main generators at this station, including the new generator, are connected to a 13.8-kv. outdoor bus. Prior to the new installation, all of the auxiliary power was supplied by transformers, also connected to the outdoor bus. Due to possible complete station interruption in case of trouble with the outdoor bus the new program includes rearranging of connections from the 10,000-kw. generator so that it can be operated either connected to the outdoor bus or independent of the outdoor bus to feed the auxiliary system.

A few years prior to this new installation the electrical supply system for auxiliaries was completely rebuilt. This system supplies the auxiliaries with energy at 220 volts, three-phase, 60-cycles. This system was extended to take care of the motors for turbine auxiliaries and the small motors for the boilers. A new 2,300 volt, three-phase, 60-cycle auxiliary bus has been installed to serve the larger motors, such as fan, pulverizer and boiler feed pump motors.

As mentioned above, the 10,000-kw. unit has been arranged to insure auxiliary power supply even with the station completely isolated, and in addition one of the boiler feed pumps is turbine driven, which will make the station auxiliary system reasonably independent of outside disturbances in the electrical system.

Building Alterations

The new turbine and its related equipment has been installed in an extension to the existing turbine room. Superstructure was extended, using in general the same type of construction as the existing building. Substructure was designed for greater water pressure due to high water than the old section of the turbine room and the existing end wall of the old turbine room structure was left in place and reinforced.

An interesting detail in this extension involved the design of the new turbine room crane. The existing crane had only 35 tons capacity and was of a four-wheel design. By using an eight-wheel design of special construction to distribute the load on the crane girder it was possible to provide a new 80-ton crane which could serve not only the new unit but also the older units without overstressing the existing crane rail. This, of course, made it possible to

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use similar crane rail construction in the new extension as in the existing building.

The equipment described in these two articles was placed in operation in August, 1939. Operation to date has indicated that the availability of the equipment has been unusually high for the first year's operation of a new installation.

•

BOOK REVIEWS

By members of Electrical Engineering Staff, M.I.T. Published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York, N. Y. 782 pages, illustrated. Price, $7.50.

As President Compton aptly puts it in the preface, this work is uniquely the product of the electrical teaching staff at Massachusetts Institute of Technology, the first of a projected series which promises to be a unified compendium of electrical engineering as it is taught. One of the objectives, well exemplified in this first volume, is to overcome the tremendous amount of duplication which would occur and has occurred in a multiplicity of books treating electric circuits from the angles of the individualist and specialist.

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•

Books Received

Television Receiving Equipment. By W. T. Cocking. *The Wireless World*, London. Price 7s. 6d.

Elements of Utility Rate Determination. By John M. Bryant and R. E. Herrmann. McGraw-Hill Book Co., New York. 464 pages. Price $4.

Legal Aspects of Engineering. By Walter C. Sadler. John Wiley & Sons, Inc., New York. 631 pages, price $4.

Mathematical Methods in Engineering. By T. V. Karman and M. A. Biot. McGraw-Hill Book Co., New York. 505 pages, Price $4.

The Measurement of Alternating-Current Energy. By D. T. Canfield. McGraw-Hill Book Co. New York. 210 pages. Price $2.

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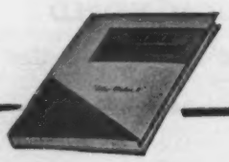

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